
OFFICE OF SCIENCE & TECHNOLOGY

Characterization,
Monitoring,
& Sensor
Technologies



April 1998 Progress Reports

Reports from FY94 to present available on the CMST-CP homepage (<http://www.cmst.org>)

*Characterization,
Monitoring,
& Sensor Technology
Crosscutting Program*

*Federal Energy
Technology
Center,
Morgantown*



Table of Contents

CMST-CP Index.....	ii
FETC Index	iv
Monthly Highlights	vi
Subsurface Contaminants	1
Plumes	1
Expedited Site Characterization	1
Field Analysis.....	3
Geophysical / Hydrologic Characterization	6
Sensors	10
Contaminant Transport.....	12
Landfills	15
Containment	15
Post-Closure Monitoring	17
Technology Survey and Verification	20
High-Level Waste Tanks.....	24
Waste Retrieval	24
Waste Sampling / Analysis.....	27
Process Monitoring.....	29
Mixed Wastes	33
Pre-Processing Characterization/Monitoring	33
Waste Process Monitoring and Control.....	38
Offgas and Effluent Monitoring	39
Disposition of Facilities (D & D).....	44
Metals and Pipes.....	44
Facility Characterization	46
Process Monitoring.....	56
Program Coordination	59
Distribution List	72

CMST-CP Index

This index lists FY98 CMST-CP projects by number, name, and document location of brief descriptions of their major activities for the month. It also identifies which technologies the project involves. ("P" indicates primary involvement.)

Project Number	Project Name	Page	Subsurface Contaminants	Tanks	Mixed Wastes	D & D	Coordination
AL27C221	New Environmental Measurement while Drilling	11	P				
AL28C221	Alternative Landfill Cover Demonstration	17	P				
AL33C231	Metal Emissions Monitor for DOE Mixed Waste Thermal Treatment	42			P		
CH15C251	Portable X-Ray, K-Edge Heavy Metal Detector	44				P	
CH17C232	Real-Time Plutonium Monitoring	38			P		
CH17C233	Development of a Multielement Metal Continuous Emission Monitor for Compliance Monitoring	41			P		
CH17C261	Characterization Crosscutting Program Technical Support at Ames Laboratory	66					P
CH26C217	Ultrasonic Sensors for <i>In Situ</i> Monitoring of Physical Properties	24		P			
CH27C231	Development of a Magnetic Resonance Monitor for Technetium-99 Column Breakthrough	30		P			
CH48C261	Characterization, Monitoring, and Sensor Technology Technical Team and Facilitator Activities	59					P
FIU7C202	Plant Stress Analysis Technology Transfer					P	
FIU8C201	On-Line Measurement of the Progress of Decontamination	56				P	
FIU8C202	Remote Surveillance of Facilities Awaiting Decontamination and Decommissioning	52				P	
FIU8C203	Measurement of Alpha Contamination on Surfaces Using an Electret Ion Chamber	53				P	
FIU8C204	Identification of DOE EM Post-Closure Monitoring Needs and Requirements	18	P				
FIU8C206	Validation and Verification of CMST-CP Sensors at the HCET Analytical Laboratory	21	P				
FT07C221	Southern States Energy Board—Privatization Pilot Project, Expedited Site Characterization		P				
HQ07C222	IAG-Air Force Development and Testing of Sonic Cone Penetrometer System		P				
ID75C221	Integrated Geophysical and Hydrological Characterization of Transport through Fractured Rock		P				✓
ID77C211	DOE Laboratory/Industry Performance Demonstration Test	37			P		
NV02C251	Associated Particle Imaging					P	
NV05C221	Environmental Remote Sensing for Monitoring Plant Health	49	✓			P	
NV05C253	Laser-Induced Fluorescence (LIF) for EM	46	✓			P	
NV06C261	Characterization Crosscutting Program Technical and Programmatic Support at Special Technologies Laboratory	64					P

CMST-CP Index - continued

Project Number	Project Name	Page	Subsurface Contaminants	Tanks	Mixed Wastes	D & D	Coordination
NV07C221	Laser-Induced Fluorescence (LIF) for Heavy Metals in Soils and Plants	48				P	
NV07C264	Current Practice of Environmental Characterization and Monitoring Technologies	20	P				
NV08C231	Integrated Raman pOH Sensor for In-Tank Monitoring	27		P			
OR17C231	Comparative Testing of Pipeline Slurry Monitors	25		P			
RL35C223	JCCM Contaminant Transport Studies (PNNL)	13	P	✓			✓
RL37C231	Development of Process Monitors for Cesium-137 Column Breakthrough	29		P			
SF14C222	Analog Site for Characterization of Fractured Rock	12	P				✓
SF24C223	Electrical Resistance Tomography for Subsurface Imaging	15	P	✓			
SR15C223	JCCM Contaminant Transport Studies (WSRC)		P				
SR16C221	Site Characterization and Analysis Penetrometer System (SCAPS) Logistics	1	P				
SR17C221	Characterization and Monitoring of Dense, Nonaqueous Phase Liquids (WSRC)	4	P				
SR17C231	Demonstration of Emerging Continuous Emissions Monitoring Technologies	39			P		

FETC Index

This index lists FY98 FETC projects by number, name, and document location of brief descriptions of their major activities for the month. It also identifies which technologies the project involves. ("P" indicates primary involvement.)

Project Number	Project Name	Page	Subsurface Contaminants	Tanks	Mixed Wastes	D & D	Coordination
AC21-92MC29101	High-Resolution Subsurface Imaging and Neural Network Recognition		P				
AC21-92MC29103	Development of a Long-Term, Post-Closure Radiation Monitor	17	P	✓			
AR21-94MC31178	A Steerable/Distance Enhanced Penetrometer Delivery System		P				
AR21-95MC31186	Measuring Fuel Contamination Using High-Speed Gas Chromatography and Cone Penetration Techniques		P				
AR21-95MC32088	Development of an On-Line, Real-Time Alpha Radiation Measuring Instrument for Liquid Streams	10	P				
AR21-95MC32089	Fiber-Optic/Cone Penetrometer System for Subsurface Heavy Metal Detection	3	P				
AR21-95MC32110	Measurement of Radionuclides Using Ion Chromatography and Flow-Cell Scintillation Counting		P			✓	
AR21-96MC33077	Tomographic Site Characterization Using Cone Penetrometer, Electrical Resistivity Tomography, and Ground Penetrating Radar	8	P				
AR21-96MC33079	Internal Reflection Sensor for the Cone Penetrometer		P				
AC21-96MC33124	<i>In Situ</i> Permeability Measurements with Direct Push Techniques	6	P				
AC21-96MC33125	Subsurface Barrier Validation with the SEAttrace™ Monitoring System	15	P	✓			
AC21-96MC33128	<i>In Situ</i> Tritium Beta Detector		P				
AC21-92MC29108	Field Raman Spectrograph for Environmental Analysis	28	✓	P	✓	✓	
AR21-93MC30363	Robotic End Effector for Inspection of Storage Tanks			P			
AC21-96MC33126	Automated Monitoring System for Fluid Level and Density in High-Level Waste Tanks			P			
AC21-92MC29115	Intelligent Inspection and Survey Robot				P	✓	
AC21-93MC30173	Waste Inspection Tomography	33	✓		P	✓	
AC21-96MC32194	A Continuous Emission Monitor for Toxic Metals in the Offgases of Thermal Treatment Facilities				P		
AC21-96MC33127	Nondestructive Examination and Assay of Drums Containing Transuranic Waste	35			P	✓	
AC21-93MC30172	Characterization for Radioactive Contamination Inside Pipes with the Pipe Explorer™ System		✓			P	

FETC Index - continued

Project Number	Project Name	Page	Subsurface Contaminants	Tanks	Mixed Wastes	D & D	Coordination
AC21-93MC30175	Portable Sensor for Hazardous Waste		✓		✓	P	
AC21-93MC30176	3-Dimensional Integrated Characterization and Archiving System (3D-ICAS)		✓		✓	P	
AC21-94MC31190	Coherent Laser Vision System				✓	P	
AR21-95MC32093	Diagnostics and Data Fusion of Robotic Sensors					P	
AR21-95MC32115	Multisensor Inspection and Characterization Robot for Small Pipes (MICROSPI)					P	
FT08C262	CMST-CP Field Coordination at Concurrent Technologies Corporation	61					P
FT08C262	CMST-CP Field Coordination at SAIC	71					P

Monthly Highlights

This section summarizes some of the most significant progress achieved within the CMST area during the reporting period. More information about each project can be found on the page indicated within each summary.

- **Site Characterization and Analysis Penetrometer System Logistics**

Recent field results showed that dense nonaqueous phase liquid (DNAPL) contamination, specifically tetrachloroethylene (PCE), is detectable using cone penetrometer based Raman spectroscopy. A team of researchers from EIC Inc., Fugro Geosciences, and the Savannah River Technology Center identified PCE in clay rich sediments in the A/M area vadose zone during three pushes in two different locations. High concentrations of PCE in these zones were previously identified by conventional coring and laboratory analyses.

The full-scale field evaluation is scheduled for late May-early June. A visitor's day is scheduled for June 4. The EIC and Lawrence Livermore National Laboratory Raman probes will be tested at three sites where DNAPL contamination has either been confirmed or is suspected. Also tested will be the EIC internal reflectance sensor for DNAPL detection. (Page 1)

- **In Situ Permeability Measurements with Direct Push Techniques**

The field prototype Cone Permeameter™ system was demonstrated at Savannah River Site in April at the D-Area Coal Pile Runoff Basin and the A/M area at the 321 M Solvent Tank pad. Fifteen people attended the Visitor's Day on April 30 to view the concurrent measurements of soil permeability and stratigraphy. (Page 6)

- **New Environmental Measurement while Drilling (EMWD)**

Sandia National Laboratories (SNL) received a letter of commitment from the Hanford Vadose Zone Program to support an EMWD 'Hot Site' demonstration at the SX Tank Farm. The demonstration will include a directional bore in a clean area adjacent to the SX Basin, and Hanford committed to fund the cost of the drilling contract, which will be let by SNL. Should the planned demonstration show that deploying EMWD technology in Hanford tank farm soils is feasible, Hanford anticipates deploying this technology in tank farm vadose zone characterization activities during FY99. (Page 11)

- **Characterization and Monitoring of Dense, Nonaqueous Phase Liquids**

The design of the hydrophobic ribbon from a form of Tyvek was completed by FLUTe Ltd. and was approved for construction. The ribbon while dusted with Sudan IV dye will cause the DNAPL to turn red and leave a visible stain on the ribbon. If the dye technique is successful, it will provide a simple and inexpensive analysis technique. The anticipated deployment of the hydrophobic flexible membrane in the vadose zone is scheduled for June. (Page 4)

Monthly Highlights - continued

- **CMST-CP Annual Review Meeting**

The FY98 CMST-CP Annual Review Meeting was held April 7 to 9 in Gaithersburg, Maryland. During the meeting, the PIs from 24 CMST-CP funded projects presented information about their progress in FY98. Nineteen of these projects were reviewed by 16 technical experts and seven Focus Area representatives; the remaining five projects were informally reviewed by the Focus Area representatives and audience members. More than 90 participants attended the meeting. All reviews have been compiled for official distribution in May. (Page 61)

- **Joint Coordinating Committee for Environmental Restoration and Management (JCCEM) Contaminant Transport Studies**

The possibility of using contaminant-migration data from Lake Karachay at Mayak in support of the Hanford Vadose Zone effort was evaluated. The initial data needed to evaluate the relevance of Lake Karachay's plume and sediment chemistry to the Hanford tank-leak question and the steps necessary to achieve the evaluation have been identified jointly with the Russian collaborators. (Page 13)

- **Nondestructive Examination and Assay (NDE/NDA) of Drums Containing TRU Waste**

The published Rapid Commercialization Initiatives results for both the Waste Inspection Tomography (WIT) and the Active and Passive Neutron Examination and Assay (APNEA) systems relating to all eight drums of data collected indicate that WIT has passed on seven of the eight drums (for NDA bias and precision), while the eighth drum is still waiting for rad chemistry results to determine if WIT passed. The APNEA system passed on two of the eight drums for bias and precision. (Page 35)

- **DOE Laboratory/Industry Performance Demonstration Test**

A report sponsored by the Mixed Waste Focus Area will examine results for both surrogate and actual waste forms. This analysis will evaluate existence of technology gaps and topics for future technology development. Based on preliminary analysis of the surrogate results, it is anticipated that few gaps will be identified related to actual instrument development. Most of the technology gaps will be associated with analysis software improvements and improved translation of density information into bias corrections. (Page 37)

- **Metal Emissions Monitor for DOE Mixed Waste Thermal Treatment**

A field demonstration of the prototype laser-induced breakdown spectroscopy monitor is scheduled for May using leveraged funds from the DOE Office of Fossil Energy. The tests will be on emissions sources in the areas of oil and natural gas production, namely engines and boilers, and are being conducted in partnership with Chevron USA. (Page 42)

Monthly Highlights - continued

- **Integrated Raman pOH Sensor for In-Tank Monitoring**

An endurance test was performed in a 10 M NaOH bath on various probe components such as stainless steel rod, epoxy, fiber-optic cable, quartz window, and sapphire window. The components were immersed in the caustic solution for ~10 months. Results show no degradation of the components under this condition. Radiation and temperature testing of the probe components will follow next. (Page 27)

Upcoming Technology Field Testing, Evaluation, and Deployment Activities*:

- **Ongoing**

Alternative Landfill Cover Demonstration at Sandia National Laboratory

- **May 1998**

In partnership with Chevron USA, field demonstration of the laser-induced breakdown spectroscopy monitor on emissions sources in the areas of oil and natural gas production, namely engines and boilers

- **May 1998**

Field test of the Thermo Alpha Monitor for measuring alpha-radiation in liquid streams at Oak Ridge National Laboratory (rescheduled)

- **June 4, 1998**

Visitors' day for the EIC and Lawrence Livermore National Laboratory Raman probes and the EIC internal reflection sensor for the cone penetrometer for detection of dense nonaqueous phase liquids at Savannah River Site

- **July 1, 1998**

Earliest date possible for installation of a process monitor for cesium-137 column breakthrough at Oak Ridge National Laboratory

- **July 1998**

Complete demonstration of a transient infrared spectroscopy monitor for Am/Cm stabilization process at Savannah River Site (tentative)

- **August 1, 1998**

Complete testing of a Hg continuous emissions monitor at an operating DOE hazardous waste treatment facility (site TBD)

- **August 3, 1998**

Begin testing of slurry transport monitors with radioactive waste at Oak Ridge National Laboratory

Monthly Highlights - continued

- **August 31, 1998**
Operation of the portable K-edge detector in a Large-Scale Demonstration Project (site TBD)
- **September 30, 1998**
Demonstration of an alpha-emitter continuous emissions monitor (site TBD)

*Due to the nature of technology development and coordination required for field events, the schedules presented are projected based on the planned progression of individual projects; they are subject to change. For those interested in participating in the field events, please contact the individual PIs before making final arrangements.

Subsurface Contaminants

Plumes

Expedited Site Characterization

Site Characterization and Analysis Penetrometer System Logistics (Westinghouse Savannah River Company)

Project objectives

The cone penetrometer is becoming the tool of choice for environmental site characterization in unconsolidated and semiconsolidated formations because it allows access to the subsurface in a rapid and cost-effective manner. Many sensors and probes for use with the cone penetrometer are being developed and demonstrated for environmental characterization by the OST.

This project is being funded to provide logistical support for field demonstrations and funding for the operation and maintenance of the Site Characterization and Analysis Penetrometer System (SCAPS) cone penetrometer by a commercial cone penetrometer company at SRS.

Accomplishments and technical progress

Raman field evaluation. Two Raman sensors, one developed by EIC, Inc., with funding from the FETC and the other at Lawrence Livermore National Laboratory (LLNL) by EM-50, will be evaluated in FY98. Raman spectroscopy is an inelastic light-scattering technique that can identify contaminants by their unique spectra. A field trial was done in the A/M area during the week of February 2 to determine whether Raman spectroscopic techniques are appropriate for direct detection of dense, nonaqueous phase liquid (DNAPL) at Savannah River Site (SRS). The results showed that DNAPL contamination, specifically tetrachloroethylene (PCE), is detectable using cone penetrometer based Raman spectroscopy. A team of researchers from EIC Inc., Fugro Geosciences, and the Savannah River Technology Center identified PCE in clay rich sediments in the vadose zone during three pushes in two different areas. High concentrations of PCE in these zones were previously identified by conventional coring and laboratory analyses.

The full-scale field evaluation is scheduled for late May-early June. A draft of the test plan is being circulated for review. A visitor's day is tentatively scheduled for June 4. Kevin Kyle, now at Special Technologies Laboratory in Santa Barbara, will participate with the probe he developed at LLNL. The EIC and LLNL probes will be tested at three sites where DNAPL contamination has either been confirmed or is suspected. Of interest is a site at the C-Area Burning Rubble Pits where soil gas concentrations were

12,000 ppmv TCE and water concentrations 130 µg/g TCE. The water table at the site is at approximately 60 feet and is more easily accessed with a cone penetrometer than in A/M Areas.

We made a request to the Southern States Energy Board (SSEB) to have them help facilitate regulatory participation in the technology evaluations. Jerry Hill of SSEB will meet during the last week in April with Jim Wright of the Subsurface Contaminants Focus Area to request assistance for two visitor's days during the technology evaluations.

An Interagency Agreement (IAG) with the Navy is being prepared to procure an *In Situ* Video Microscope from NCCOSC for the SCAPS truck. We requested and received technical information on the equipment, and the IAG is being prepared. Recent work at the Alameda Naval Air Base by Steve Lieberman shows the presence of what appears to be a separate phase in the contaminated zone. The equipment is scheduled to be evaluated in September.

SEA permeability probe. The SEA Cone Permeameter™ system was demonstrated at SRS during April. This system, deployed with the cone penetrometer truck allows *in situ* measurement of air permeability and saturated hydraulic conductivity with direct push techniques. This system uses a fluid injection and pressure measurement array integrated in a cone penetrometer rod section. Using several pressure measurement locations on the rod section, the method is capable of avoiding the impact of the compressed soil adjacent to the penetrometer rod section on the measured permeability.

Field activities with Cone Permeameter™ testing were initiated at well DCB-25 adjacent to the D-Area Coal Pile Runoff Basin. The initial testing focused on measurements in the saturated zone in different lithologies. Some difficulties with clayey material plugging the water injection screen were encountered. Subsequent pushes were made while pumping water at a low flow-rate through the descent to keep the screen clear. This technique worked, and measurements were taken at discrete intervals. The truck was moved to the M-area, and additional measurements were made in the saturated zone.

The visitor's day was held April 30. About 15 participants attended. The field work will be completed May 1. The second implementation at the Old Burial Ground will be postponed until the end of the month because of contracting delays.

Applied Research Associates (ARA) cone penetrometer with ground penetrating radar and electrical resistance tomography (ERT). The FETC contract with ARA was extended to provide funding for ARA to participate in the evaluation. A meeting with Jim Shinn and Dave Timian from ARA was held April 23 at SRS. Their preferred site for implementation is the GeoSiphon well located in the floodplain of the Savannah River at TNX. The GeoSiphon well is a large-diameter well (8-inch diameter) where the gravel pack around the screened interval is composed of granular iron particles.

Flow in the system is driven by a siphon line from the well to the river. This is a passive treatment system used to remediate volatile organic compounds (VOCs), primarily TCE and carbon tetrachloride, in the groundwater. Depending on the results of calculations using measured conductivities from the GeoSiphon borehole, the ERT system may be used to delineate the zone of influence of the treatment well. It is proposed that a conductive tracer such as sodium bromide will be added to a monitoring well. A transect across the flow line will be imaged prior to initiating flow in the well. Flow will be initiated, and several measurements will be made at designated intervals (days) to determine the effect of the well on the flow pathline. The curvature of the path will be compared to that determined using groundwater modeling.

EIC internal reflectance sensor (IRS). Negotiations continue between the FETC and EIC to fund EIC's participation in the implementation of the EIC IRS during June. The Phase 2 contract award is pending and will be used to fund the first implementation. We will be notified during the first week in May whether EIC will have funding to participate in June.

PI: Carol Eddy-Dilek, Westinghouse Savannah River Company, (803) 725-2418

Field Analysis

Fiber-Optic/Cone Penetrometer System for Subsurface Heavy Metal Detection

Project objectives

The project objective is to develop an integrated fiber-optic sensor/cone penetrometer system to analyze the heavy metals content of the subsurface. This site characterization tool will use an optical fiber cable assembly that delivers high power laser energy to vaporize and excite a sample *in situ* and return the emission spectrum from the plasma produced for chemical analysis. The chemical analysis technique, often referred to as laser-induced breakdown spectroscopy (LIBS), was recently shown to be an effective method for the quantitative analysis of contaminants in soils. By integrating the fiber-optic sensor with the cone penetrometer, it is anticipated that the resultant system will enable *in situ*, low cost, high resolution, real-time subsurface characterization of numerous heavy metal soil contaminants.

Major milestones

- Fabrication and evaluation
- Design of prototype

Significant events

Surface LIBS characterization of beryllium-contaminated soil at the Formally Utilized Sites Remedial Actions Program (FUSRAP) Luckey, Ohio site.

Accomplishments and technical progress

Work continued on the modifications to the LIBS probe to improve the reproducibility of the laser light delivery in the field. Three modifications were considered:

(1) increasing the inner diameter of the penetrometer rod from 1 inch to 1.25 inches to allow for more room for the laser tube assembly; (2) cladding the copper laser tubes with stainless steel to increase stiffness and reduce the bending losses; and (3) using a laser diode as an aid to assembling the rod straight. Only the first two modifications were implemented. The third was tried and determined to be too sensitive to other factors to be useful.

The Hanford site demonstration opportunity was delayed because of the most recent technical issues, and the site has re-allocated their efforts to other areas. The Hanford contacts submitted requests for additional funds to support a future demonstration of LIBS at the site. An alternate site at Sandia or Los Alamos is being reviewed.

Assessment of current status

The schedule for field demonstration was delayed because of the change in the DOE demonstration site from Hanford to another to-be-determined site. No cost impact was finalized yet from this change.

Plans for the next two months

The field demonstration site will be selected. The work plan for the field demonstration will be completed and submitted for review by the site. The field demonstration will be performed.

PI: Stephen Saggese, Science & Engineering Associates, Inc., (619) 294-6982

FETC COR: Karen Cohen, (412) 892-6667

Characterization and Monitoring of Dense, Nonaqueous Phase Liquids (Westinghouse Savannah River Company)

Project objectives

The objectives of this project are to develop and evaluate direct and inferential methods for detecting dense, nonaqueous phase liquid (DNAPL) in the subsurface. The characterization methods planned for evaluation and development are targeted to address DNAPL characterization in the context of effective DNAPL remediation strategies. To this end, minimally invasive, focused technologies that provide unique

and unequivocal results are emphasized. Small-scale tests addressing DNAPL held in thin, highly discrete zones are planned to complement larger scale tests being conducted at other sites. The DNAPL characterization tools include: spectral gamma logging of natural radionuclides (that preferentially partition to DNAPL) in existing monitoring wells; small-scale alcohol injection extraction tests that will be delivered using the cone penetrometer (CPT); small-scale differential partitioning gas tracer tests, optical spectroscopic methods delivered by CPT, and related methods. These technologies will complement tools currently used/proposed by industry, the EPA, and the DOD.

Accomplishments and technical progress

FLUTe is fabricating the hydrophobic ribbon from a form of Tyvek that will be dusted with Sudan IV dye. The dye will cause the DNAPL to turn red and leave a visible stain on the ribbon. If the dye technique is successful, it will provide a simple and inexpensive analysis technique. The design of the ribbon was completed by FLUTe Ltd. and was approved for construction. The anticipated deployment of the hydrophobic flexible membrane in the vadose zone is scheduled for June.

A contract under South Carolina Universities Research and Education Foundation (SCUREF) with Mike Angel in the Chemistry department of the University of South Carolina (USC)-Columbia is in progress for additional spectral analysis of co-constituents in support of the spectral analysis techniques for DNAPL. Testing will consist of the acquisition of excitation (absorption) and emission spectra for approximately 25 compounds under varying excitation wavelengths.

The first draft of the Raman CPT probe evaluation test plan under the CMST-CP Site Characterization and Analysis Penetrometer System (SCAPS) program is complete. The evaluation is scheduled for two weeks beginning May 26. The EIC and Lawrence Livermore National Laboratory probes will be tested at three sites where the hydrophobic membrane, PIX probe, and laser-induced fluorescence probes will be developed. We will leverage the CMST-CP work that will provide the confirmatory soil sampling for these sites. Of interest is the new site at C-Area Burning Rubble Pits where soil gas concentrations were 12,000 ppmv TCE and water concentrations 130 µg/g TCE. The water table at the site is at approximately 60 feet and is more easily accessed with a CPT than in A/M Areas.

Plans for the next two months

The Raman CPT probe evaluation is scheduled for two weeks beginning May 26.

The anticipated deployment of the hydrophobic flexible membrane in the vadose zone is scheduled for June.

PI: Joseph Rossabi, Savannah River, (803) 725-3692

Geophysical/Hydrologic Characterization

***In Situ* Permeability Measurements with Direct Push Techniques**

Project objectives

The project objective is to develop the measurement model, validate it in the laboratory, and perform a field test of a prototype *in situ* permeability measurement system integrated with direct push techniques such as cone penetrometers. This effort involves two major thrusts: development of a measurement model that will perform in the cone penetrometer operating environment and engineering the measurement package to satisfy the size and operational constraints of penetrometer applications.

Major milestones

- *In situ* permeability measurements
- Phase 1 R&D

Significant events

The field prototype Cone Permeameter™ system was demonstrated at Savannah River Site (SRS) in April at the D-Area Coal Pile Runoff Basin and the A/M area at the 321 M Solvent Tank pad.

Accomplishments and technical progress

The saturated and unsaturated zone demonstration measurements were complete at SRS in April. The general chronology of the field tests is as follows:

April 21—Neva Mason and Bill Lowry of Science and Engineering Associates arrived at SRS in the morning and toured the measurement areas. Mike Serrato and Bill Jones of Westinghouse Savannah River provided documents of characterization activities at the sites. A temporary office area was provided for instrument checkout and data analysis. The Cone Permeameter™ equipment arrived mid-day, and setup/checkout was started. Chris Bianchi of Applied Research Associates (ARA) arrived that evening.

April 22—Measurement system tests and calibrations showed that the electronic air flowmeter had failed, so it was sent back to the manufacturer for repair. A replacement was ordered as backup. One of the pressure sensors embedded in the cone penetrometer (CPT) rod section also indicated sporadic signals, so the rod was disassembled, and the bad sensor was replaced. The rod was reassembled, and it tested out satisfactorily. The test plan was changed to conduct saturated zone tests first, allowing sufficient time for the replacement air flow sensor to be express shipped to the site.

April 23—Mobilized the ARA CPT truck to the D-Area Coal Pile Runoff Basin for the saturated zone tests. At this location, the water table is between 4 and 5 feet below ground surface. Saturated hydraulic conductivity tests were started at shallow depths. Initial tests showed that the injection zone was repeatedly plugging. The rod was

retrieved and cleaned, and the procedure was changed to always sustain water flow into the injection zone during the push to prevent clay from plugging the injection screen. Compounding this was the occasionally very high pore pressure generated during the rod push (as high as 200 psi in some cases) in clays, caused by the compaction of the pore spaces adjacent to the rod. This pressure probably forced clay into the injection screen plugging the injection water flow. Injecting water (at a very low rate) continuously during the push eliminated almost entirely the plugging problem.

April 24—The CPT truck was moved to another location (about 10 feet from the first push) to start a clean measurement series. By the end of the day, several measurements were completed to the 15-foot depth.

April 27—The measurements in the D-Area saturated zone were completed to the total depth of 60 feet. Thirty-five measurements were conducted in five hours. In some cases the permeability was so low that water could not be injected into the clays (consistent with very high pore pressures and very slow dissipation of these pore pressures).

April 28—The CPT truck was relocated to the Integrated Demonstration site (Area M) for the unsaturated zone air permeability measurements. Plugging of the pressure sensor filters with clay impeded initial measurement attempts. Removal of the rod, cleaning, and reinsertion would temporarily allow air measurements, but the ports rapidly plugged as soon as the rod was advanced through the clay. High pore pressures were measured during the push in the clay zones, indicating that the clays were close enough to saturation that they could accumulate elevated pore pressure as if they were in the saturated zone. Because of the field schedule constraints, we decided to move the CPT rig over to the 321 M Area, which was the site selected for the Visitors' Day.

April 29—The CPT truck was located at the building 321 M Area site, where air permeability measurements were planned. Two air flow meters were available. Several measurements were conducted, with similar results due to clay layers plugging the pressure port filters. The geophysical data obtained by the standard cone measurements indicated the location of higher permeability (sand) layers, and measurements were successful in those regions. Preparations were made for the Visitors' Day.

April 30—The Visitors' Day activities started at 8:30 a.m., with a briefing on the technology and the site characteristics. Mike Serrato introduced the project and site information, and the PI presented the technology description and results obtained to date. Fifteen people attended the briefing. The attendees were then transported to the 321 M Area to see the Cone PermeameterTM measurements in progress. That morning the probe was retrieved from the soil, cleaned, and pushed back to depth. A successful air measurement was obtained at that location, and the balance of the air measurements were completed in the remaining work day. The operations were completed, and the

hole was grouted up. The measurements in the saturated zone were considered highly successful. Results are being compared with other measurements taken at the site. In general, the permeability at the site is highly variable, corresponding with the detailed layering of clay, sand, and silt. Concurrent measurement of the cone penetrometer geophysical data proved to be extremely useful in anticipating the measurement conditions and frequently explained difficulty in obtaining permeability data. When the measurement system was in the production mode, approximately 8 to 10 minutes were required for the average measurement (including the time to push the rod to the next depth). Measurements were typically obtained on 1-foot spacing. Air measurements were problematic, primarily due to plugging of the pressure ports with clay. When the ports were cleaned, good measurements were obtained in the higher permeability zones (in particular, the sand layers). In the clay layers, it was frequently not possible to flow air at all because of the clay's inherent low permeability and probably zero air permeability (possibly due to the compaction of the clay by the penetrometer during the push). Several changes in the pressure port filter design are being considered to prevent the accumulation of clay over the porous filter. We would expect to have greater success with air permeability measurements in sites with lower moisture and/or less clay.

Assessment of current status

Field demonstration testing was completed April 30. The Phase 2 topical report is being prepared.

Plans for the next two months

Complete the Phase 2 topical report.

PI: Bill Lowry, Science & Engineering Associates, Inc., (505) 424-6955

FETC COR: Karen Cohen, (412) 892-6667

Tomographic Site Characterization Using Cone Penetrometer, Electrical Resistivity Tomography, and Ground Penetrating Radar

Project objectives

The objective of this project is to incorporate electrical resistivity tomography (ERT) and ground penetrating radar (GPR) tomography with improved cone penetrometer (CPT) techniques for advanced site characterization. ERT and GPR are geophysical characterization methods capable of high resolution imaging. Using the CPT as a delivery system to install ERT electrodes and GPR antennas offers ease of operation, reduced costs, and minimal invasiveness.

Major milestones

- ERT design
- GPR design
- Pre-prototype
- FOP/report
- Tomographic site characterization
- Complete current contractual phase and determine future actions

Significant events

The prototype system was field tested at a pump test site at Savannah River in October 1997.

Accomplishments and technical progress

Jim Shinn traveled to Savannah River Site and investigated the possibility of conducting CPT, ERT, and GPR field experiments at two tentative sites. The first site is in the A/M area, and after careful consideration it was judged to be the second choice because of schedule uncertainties and the amount of cultural clutter that would possibly interfere with the GPR and ERT measurements. The primary site is at the TNX area and involves a GeoSiphon being used as part of a TCE groundwater remediation method. The area is generally free from most cultural clutter, and a preliminary field experiment is being designed. Because the GeoSiphon is a 1-foot-diameter well in the middle of 8 feet of iron filings to the depth of approximately 20 feet, its capture zone is difficult to determine under variable flow conditions. We propose monitoring the GeoSiphon's influence remotely using the ERT, CPT, and GPR system in conjunction with a type of tracer test, where the tracer will change the total observed conductivity of the site and its movement towards or beyond the GeoSiphon will be monitored remotely using CPT-installed ERT and GPR tomography.

Assessment of current status

The project is on schedule and on budget.

Plans for the next two months

Finalize test site and submit work plan for testing and data analyses.

PI: Rex Morey, Applied Research Associates, (802) 763-8348

FETC COR: Karen Cohen, (412) 892-6667

Sensors

Development of an On-Line, Real-Time, Alpha-Radiation Measuring Instrument for Liquid Streams

Project objectives

The overall objectives are to develop a large surface area detector with multiple-jet-impingement mass transfer for maximum sensitivity and response speed, and to demonstrate the instrument's effectiveness through testing on a variety of DOE site surface, ground, and process waters. The Thermo Alpha Monitor (TAM) will satisfy important DOE needs in several Focus Areas. The subsequent widescale commercialization of TAM across the DOE complex will result in significant cost savings, while simultaneously improving the quality and timeliness of alpha monitoring.

Major milestones

Task 2.2, assembly and inspection of system, is 97% complete. Some more windows programming to automate the mechanical subsystems must be done. This should be completed before the field testing.

Significant events

The PI traveled to Oak Ridge National Laboratory (ORNL) this month in preparation for the field work to be completed in May to determine all permit requirements and inspect the actual sites to be used for testing. During this visit, Y-12 plant personnel expressed great interest in using the TAM for multiple installations at which they will be required to monitor uranium on a more or less continuous basis. A related technology to enable detection of alpha in air was awarded to Tecogen this month. The instrument will be developed for use in the vitrification process and can be applied to nuclear test ban treaty compliance monitoring as well.

Accomplishments and technical progress

In preparation for a field test at ORNL this year, the contractor successfully operated the TAM with a 5-kW generator set that they will use at the remote field location, with only minor degradation of sensitivity.

Assessment of current status

There are no cost or schedule variances.

Plans for the next two months

The field work will be performed in May at ORNL, following final preparation of the instrument and functional testing. Following the field work, a final report will be prepared; this will close out the project.

PI: Keith Patch, Thermo Power Corp. (Tecogen Division), (781) 622-1400

FETC COR: Richard Bush, (412) 892-6426

New Environmental Measurement while Drilling

Project objectives

This project has demonstrated a radiation sensor and will provide additional sensing capabilities to an operational Environmental-Measurement-While-Drilling (EMWD) platform. Specific sensors for integration include a magnetometer for continuous distance and depth measurement capability as well as a heavy metal sensor.

Significant events

R.A. Normann, G.J. Lockwood, and C.V. Williams presented “Integration and Evaluation of a Position Sensor with Continuous Read-out to be Used with the Environmental Measurement-While-Drilling Gamma Ray Spectrometer System” at No Dig '98, April 5 to 8.

Accomplishments and technical progress

Sandia National Laboratory (SNL) Technology Transfer is in negotiations with Charles Machine Works, Inc. for the licensing of the cable coil. They are seeking an exclusive license in all fields of use. We expect to have a signed agreement within the month.

We received a letter of commitment from the Hanford Vadose Zone Program to support an EMWD ‘Hot Site’ demonstration at the SX Tank Farm. Additionally, Hanford committed to fund the cost of the drilling contract, which will be let by SNL. We are developing a schedule, statement of work for the drilling contract, and a demonstration plan. The primary barrier is the Hanford geology, and it must be shown that the directional drilling can be successful in the environment. The demonstration will include a directional bore in a clean area adjacent to the SX Basin to verify that this drilling method has a high probability of success. If a directional borehole can be drilled, EMWD has a high probability of successfully characterizing the SX basin subsurface. Should the planned demonstration show that deploying EMWD technology in Hanford tank farm soils is feasible, Hanford anticipates deploying this technology in tank farm vadose zone characterization activities during FY99.

Assessment of current status

The project is within budget and on schedule. However, negotiations with Hanford on ‘Hot Site’ demonstration are proceeding slowly, and there is a slight concern that the demonstration may not be completed by the end of the fiscal year. We are working with Hanford to resolve all safety issues and to expedite the transfer funds for the drilling contract.

PI: Cecelia Williams, Sandia National Laboratory-Albuquerque, (505) 844-5722

Contaminant Transport

Analog Site for Characterization of Fractured Rock

Project objectives

This project will concurrently develop a conceptual model and a suite of reliable tools and methods for field monitoring that can be used together for characterizing, monitoring, and controlling flow and contaminant transport in fractured rock. This is a non-trivial task because flow and transport through fractured rock are complex, poorly understood phenomena. Such basic questions as “Where does contamination go?”, “How fast does it get there?”, and “How can we monitor flow and transport processes?” must be answered before we can expect to be able to answer the ultimate question, “How can the contamination be removed or isolated?”

Major milestones

- Complete analysis of drilling through fast flow feature and document results in a letter report; due 12/15/97. Completed on time.
- Complete Web site archive of project data and information (see <http://www-esd.lbl.gov/ERT/inel/inel.html> and choose ‘Data Holdings’); due 4/30/98. Completed on time.
- Complete analysis of gas tracer test at the Radioactive Waste Management Complex (RWMC); due 6/30/98. This milestone will be reformulated. The tracer test being conducted by Idaho National Engineering and Environmental Laboratory (INEEL) personnel (independent of this project) will not be complete by 6/30/98.
- Complete project closeout and document all project activities in a letter report; due 9/15/98.

Significant events

We integrated a description of data holdings into the Fracture Analog project Web site. Included are data collected from the Box Canyon field site during the summer field seasons of 1996 and 1997, in which ponded infiltration tests were conducted. These data are available upon request to the EM community, as described on the Web site (URL: <http://www-esd.lbl.gov/ERT/inel/inel.html>).

Two journal articles concerning work conducted at Box Canyon are in review. The paper by P. Zawislanski and B. Faybishenko, “New casing and backfill design for neutron logging access boreholes,” was revised according to reviewer comments and sent to *Groundwater Journal*. “Near surface wetting of a ponded basalt surface: observations using time domain reflectrometry” by R. Salve is in review with the *Journal of Hydrology*.

Accomplishments and technical progress

In FY98, we are closing out the work initiated in FY95.

We conducted a series of numerical simulations of the pressure and flow response to the gas-phase tracer test being designed for the RWMC, and preliminary results were delivered to INEEL and discussed with the INEEL project PIs.

We visited the Box Canyon field site to inspect the equipment and the state of the site.

Assessment of current status

We spent \$19.7 K during April, which is greater than the budgeted amount of \$12 K. The over-run arose because labor that was expected to be spread out over several months all occurred in April.

Plans for the next two months

We will finalize the reformulation of the milestone to analyze the gas tracer test, continue analysis of 1997 infiltration test data, and continue developing the conceptual model for flow and transport in the fractured basalt vadose zone.

PI: Christine Doughty, Lawrence Berkeley National Laboratory, (510) 486-6453

**Joint Coordinating Committee for Environmental Restoration and Management (JCCEM)
Contaminant Transport Studies (Pacific Northwest National Laboratory)**

Project objectives

This project will assess the hydrogeologic framework and contamination of the nuclear production sites in the West Siberian Basin using all available information sources, including direct interactions with Russian scientists, to benefit the DOE EM efforts in the U.S. and in technical interchanges with the Russians.

Major milestones

Complete FY98 project report; due 9/30/98.

Significant events

We completed the camera-ready copy of the English translation of the Russian book "Deep Injection Disposal of Liquid Radioactive Waste in Russia" for publication by Battelle Press.

Accomplishments and technical progress

Adam Hutter, DOE Environmental Measurements Laboratory (EML), and the PI met on April 9 with Gerald Boyd and Charles Nalezny of EM-50 to discuss project plans for FY99. We were asked to evaluate the possibility of using contaminant-migration data from Lake Karachay at Mayak in support of the Hanford Vadose Zone effort. At month's end, we had identified with our Russian counterparts the initial data needed to

evaluate the relevance of Lake Karachay's plume and sediment chemistry to the Hanford tank-leak question and the steps necessary to achieve the evaluation.

We received the missing essential site characterization data for half the model area from Hydrospeztzgeologiya and completed digitizing them. We queried Hydrospeztzgeologiya for the transfer schedule for the remaining data and received the reply that they will be sent to the DOE by month's end. We initiated conversion of our Mayak model grids to the Russians' Mayak plane coordinate system, which is the final step in preparing for model calibration runs using the new characterization data.

Assessment of current status

This project is on schedule.

Plans for the next two months

We will complete integration of the new Mayak site characterization data and our model grids into the final 3D site hydrogeologic model in preparation for the U.S.-Russian model calibration workshop to be held at Pacific Northwest National Laboratory July 11 to 25. We will develop a statement of work for Russian collation and synthesis of Lake Karachay contaminant-migration data to determine their relevance to Hanford tank-leak contaminant migration.

PI: Michael Foley, Pacific Northwest National Laboratory, (509) 372-4671

Landfills

Containment

Electrical Resistance Tomography for Subsurface Imaging

Project objectives

Electrical resistance tomography (ERT) has been developed to map changes in formation water content caused by the subsurface processes of electrokinetic remediation and leaks from waste storage tanks. In FY98, this project will evaluate the utility of ERT for monitoring the emplacement of jet grouting and viscous liquid barriers. Additionally, a field experiment to map the extent of subsurface free product dense nonaqueous phase liquids (DNAPLs) using a combination of downhole Raman fiber-optic sensor and cross borehole electrical impedance tomography (for magnitude and phase of the resistivity as a function of frequency) will be conducted.

Accomplishments and technical progress

Planning began for the ERT - DNAPL experiment: (a) negotiations for an experimental site and (b) calculation of EM coupling effect at high frequencies.

A rough draft is completed of a paper reporting the work on the Brookhaven and Dover barriers projects.

The contract with Steam Tech is in place. Work began on Autopilot, and we are monitoring that contract.

Assessment of current status

The project is on schedule, and the cost is on target.

PI: Bill Daily, Lawrence Livermore National Laboratory, (510) 422-8623

Subsurface Barrier Validation with the SEAttrace™ Monitoring System

Project objectives

The project objective is to develop and demonstrate an integrated methodology and field system to evaluate the integrity of *in situ*, impermeable barriers constructed in the vadose zone. The methodology relies on the predictable process of binary diffusion of a tracer in the soil gas. A known concentration of tracer gas would be placed on one side of the barrier wall, and soil gas samples would be drawn from known locations on the other side. Using inverse modeling methodology, the history of soil gas concentration at the various sampling locations allows determination of the leak location and its size.

Major milestones

- Field evaluation in subscale subsurface barrier

Significant events

The PI presented the results of the Phase 1 work and plans for Phase 2 at the CMST-CP Annual Review Meeting.

Accomplishments and technical progress

The search for a host site to demonstrate the SEAttrace™ barrier verification and validation technology has targeted both government agencies and commercial companies. More than 200 separate barriers (primarily slurry walls) were identified. Of these, approximately three quarters were determined to be unacceptable for testing (the barriers were located in highly saturated media, or the barriers did not extend to the surface). Contact with site personnel was made with approximately half of the remaining barriers. The majority of those contacted were uninterested in hosting a demonstration. Reasons given included liability for personnel safety at hazardous sites, difficulty in obtaining the necessary agreement among responsible parties at the site, lack of a realized benefit to the site owners, etc. Given the responses, the search for a host site was narrowed to sites owned and/or maintained by the federal government or to sites where the barrier is no longer an integral part of the containment system. While we have several possibilities in the search list, we can still use any assistance that the DOE EM can offer to locate a good demonstration site.

The SEAttrace™ monitoring system data acquisition and inversion codes are being evaluated for changes and improvements. We anticipate making only those changes necessary to reduce the overall sampling and analysis time and improve the operability of the system (ease of use in the field).

Assessment of current status

The pace of the project is dictated now by locating a suitable demonstration site.

Plans for the next two months

Continue the search for a test barrier and select the test site. Modify the field system.

PI: Bill Lowry, Science and Engineering Associates, (505) 424-6955

FETC COR: Karen Cohen, (412) 892-6667

Post-Closure Monitoring

Development of a Long-Term, Post-Closure Radiation Monitor

Project objectives

Babcock and Wilcox will develop a low cost, multi-point radiation monitoring system for the long-term continuous monitoring of radiation levels in the vadose zone of hazardous waste sites. The system will be based on gamma spectroscopy and will be capable of monitoring to depths of more than 50 meters below ground level without necessitating the drilling of wells.

Major milestones

- Testing and subscale system design
- Demonstration of subscale integrated system
- Demonstration of prototype system
- Post-closure monitor; complete field testing and deploy the long-term, post-closure radiation monitor at Fernald for subsurface contaminants

Accomplishments and technical progress

Two probes were removed from the flyash pile in March because of restoration work in that area. The probes are in storage at Fernald while we await the preparation of new locations in two drum storage buildings on the site. Fernald personnel are working on the building modifications and associated hardware. The reinstallation of the probes is now expected to occur in late May or early June. The other three probes are operating normally.

PI: Stuart Reed, McDermott Technologies, (330) 829-7350

FETC COR: Jagdish Malhotra, (304) 285-4053

Alternative Landfill Cover Demonstration

Project objectives

The Alternative Landfill Cover Demonstration (ALCD) is a large-scale field test at Sandia National Laboratory. Two baseline covers (traditional Resource Conservation and Recovery Act subtitle 'D' for municipal landfills and traditional Resource Conservation and Recovery Act subtitle 'C' for hazardous mixed waste landfills) are constructed side-by-side with four alternative cover designs for comparison based on performance, cost, and ease of construction. The covers are being monitored for all water balance variables and supporting data. This field-obtained data will be compared with results obtained from predictive computer models for validation of the models. In addition, five years of water balance data would be deemed adequate for regulatory

approval of the alternative covers, and this project is expected to complete data collection by the year 2001.

Major milestones

Report generation of data analysis is due at the end of the fiscal year. All milestones (reports) are on schedule.

Significant events

The PI presented information about the analysis of data through March 1998 in an article to be published in *Civil Engineering* magazine.

Accomplishments and technical progress

Automated data collection continued through the month. Completed analysis of data through March 1998. Collected soil samples for nutrient analysis to detect changes from a year earlier.

Assessment of current status

The project schedule and cost are as planned.

PI: Steven Dwyer, Sandia National Laboratory, (505) 844-0595

Identification of DOE EM Post-Closure Monitoring Needs and Requirements

Project objectives

The 2006 plan sets an ambitious agenda for the DOE EM's cleanup work. Its primary objective is to reduce overall clean-up costs by first eliminating the environmental problems that are most expensive to control and safely maintain. This approach has also been described as eliminating EM's mortgage.

In the context of *Accelerating Cleanup: Focus on 2006*, closure refers to the completion of area- or facility-specific cleanup subtasks. Little to no EM land will be remediated to "residential use" levels; most will be remediated to "industrial use" levels with access restrictions, while some areas will be closed off through containment. Most of the industrial use and closed-off lands will require monitoring. In the restricted and waste storage areas, the waste levels, condition, and containment will need to be monitored. In the nearby areas, groundwater and soils will need to be monitored per monitoring requirements imposed by regulators and stakeholders. Regulators will not approve closure plans without the specification of clearly defined monitoring methods using approved technologies. Therefore, inadequate planning for monitoring and the lack of appropriate monitoring technologies often prevent closure.

The current and evolving post-closure monitoring requirements at DOE EM sites must be determined, documented, and tracked to provide the CMST-CP with information to guide its post-closure technology development and deployment efforts. In this project, the Florida International University Hemispheric Center for Environmental Technology (FIU- HCET) will determine and track post-closure monitoring needs at DOE EM sites. The primary deliverable will be a DOE EM post-closure monitoring needs summary with an analysis showing the most commonly occurring needs.

Accomplishments and technical progress

After researching the 2006 Plan, the following information was found:

The DOE EM has a responsibility to the health and safety of the public; thus, it will be required to maintain surveillance and monitoring at most sites.

Those responsible for cleanup at sites provided assumptions and planned end states. This information was found in each site draft cleanup strategy.

The Hanford Web site has been reviewed, and pertinent documents are being ordered.

Post-closure documents from the Savannah River Site were requested.

The following documents governing post-closure at Fernald were received, and are being thoroughly reviewed:

- On-Site Disposal Facility Post-Closure Care and Inspection Plan
- On-Site Disposal Facility Groundwater/Leak Detection and Leachate Monitoring Plan
- Integrated Environmental Monitoring Plan

Plans for the next two months

Review all available documents, continue research on the Hanford and Savannah River sites, and initiate site activities at the Hanford and Savannah River sites.

PI: M. A. Ebadian, Florida International University, (305) 348-3585

Technology Survey and Verification

Current Practice of Environmental Characterization and Monitoring Technologies

Project objectives

This project will document current practices of environmental technologies in the areas of site characterization and waste/processing monitoring. This activity will (1) collect, assess, and compile information from technology users and purchasers in DOE and EPA environmental management programs and (2) produce a draft document for review by technology users, purchasers, and project sponsors. The document will be published in print form and on the World Wide Web (WWW) with search and interactive capabilities. Additional technologies used in other federal programs (i.e., DoD, DoC, DoI) as well as at private company sites will be included in the out-years. This project is important to the DOE user community and to DOE cost analysis management because it (1) provides a comparison of innovative technologies with baseline technologies to determine cost savings; (2) documents the use of innovative technologies within the DOE complex; and (3) enhances communication within the user community about how similar problems are being handled.

Major milestones

- Develop database; due 3/31/98. This milestone has been completed.
- Update database for DOE sites; due 9/20/98.

Significant events

The PI discussed the database with some CMST-CP Annual Review Meeting attendees.

Accomplishments and technical progress

The Web-based survey was revised. Existing survey data were placed into the database via WWW entry.

Assessment of current status

The cumulative schedule variance is -66%, primarily because of delayed placement of subcontracts that were not required as originally scheduled. The effort will increase in future months, and should finish on schedule. The cumulative cost variance is 0%.

Plans for the next two months

- Receive approval for the survey to be made publicly available on the WWW and linked to the CMST-CP pages.
- Request review of Web-based survey pages by FY97 panel of experts that assisted in site visits and survey development. Contact Site Technology Coordination Group CMST liaisons for survey review and feedback, as well as data entry referrals.
- Develop initial visualization data analyses.

PI: Stephan Weeks, Special Technologies Laboratory, (805) 681-2262

Validation and Verification of CMST-CP Sensors at the Hemispheric Center for Environmental Technology (HCET) Analytical Laboratory

Project objectives

This project is to verify field data obtained by deployed technologies for the closure and post-closure of various waste sites throughout the country. The sensors used by these technologies are to be validated to establish criteria for conditions that provide users, regulators, and stakeholders with confidence that the site is clean based on the agreed-upon standards. Validation of the data is intended to ensure that they are accurate and precise and that they describe the true state of the location to which they are applied. This project scope also includes examination of existing DOE needs to identify other validation or characterization opportunities that could be initiated immediately.

Significant events

We attended the CMST-CP Annual Review Meeting to interact with other CMST-CP personnel and present the capabilities of the HCET Analytical Laboratory to further the validation and verification program arising out of applied technologies for closure and post-closure.

This month, we were visited by Pam Greenlaw in charge of the Environmental Measurements Laboratory CMST Laboratory. She was given a tour of the laboratory facilities, and the possible interaction of HCET with her facility was discussed.

Accomplishments and technical progress

We examined the list of needs cited by the Oak Ridge Site in their Technology Needs Database Web page (<http://eagle.emweb.icx.net/techneed/>). The needs were examined under the broad categories of analysis and performance, characterization, treatment, closure, *in situ* treatment, and containment. Additionally, attention was given to the priority level stated in the needs statements. The potential projects are listed in this report in approximate order of priority, although the priority criteria are not always based on the same group; rather, some are listed as a priority within a subgroup, e.g., mercury contamination.

The following projects present potential validation work by HCET.

- *Need # DD-01: (Very high priority) Radiological characterization of contaminated equipment and facilities*
Confirmation of field-deployable equipment
- *Need # WM-13: Continuous measurement of total, elemental, and speciated gaseous, toxic metals effluents*
Validation of real-time monitoring system

- *Need # BW-03: In situ assay systems*
Evaluation of low-level waste; mixed waste; corrosives; oxidizers; reducing agents, organics, transuranic waste (TRU), polychlorinated biphenyls; and picric acid in burial grounds, seepage pits, soils, and burn areas. Good opportunity to evaluate many technologies that may be applied for remediation.
- *Need # HY-13: Treatment of groundwater plumes with reactive materials*
This project may have relevance to a proposal that was submitted to Fernald regarding interaction of water with liner materials.
- *Need # WM-27: Nondestructive assay performance demonstration of TRU*
Verification of assay performance by possible round robin involvement
- *Need # HG-15: In situ methods for reducing mercury in influent streams*
Verification of meeting requirements for extremely low concentration detectability at ng/L level
- *Need # HG-16: Nondestructive device to detect mercury in water or aqueous solutions*
Confirmation of technology performance will be required.
- *Need # WM-06: Removal of nitrates from aqueous waste in the presence of radionuclides*
HCET may be able to play a key role based on our nitrate to ammonia conversion (NAC) experience.
- *Need # WM-12: Decontamination of scrap metal*
Use of HCET's X-ray dispersive analysis system can provide confirmation of contaminant removal.
- *Need # HY-15: Vapor phase treatment alternatives*
Verification of destruction of chlorinated solvent vapors using systems other than carbon absorption type
- *Need # BW-19: Remediation of secondary soil contamination*
Involves confirmation of characterization of soil contaminated with radionuclides, heavy metals, and/or volatile organic compounds
- *Need # WM-23: Treatment of heterogeneous waste*
Confirmation of effectiveness of removal of organic contaminants from waste
- *Need # WM-15: Removal of lithium from aqueous waste*
Validation using atomic absorption spectrophotometer
- *Need # HY-04: Volatile organic compound monitoring and detection*
Verification of performance of field measurements; use of HCET Analytical Lab gas chromatograph/mass spectrometer (GC/MS)

- *Need # WM-14: Long-term performance of final waste forms*
Modeling of mechanisms for release of radioactive and toxic constituents

Plans for the next two months

We will continue to submit these potential needs to our facilitator, Glenn Bastiaans, and to further discuss opportunities with key CMST-CP personnel. We will also continue to evaluate other site needs.

PI: M. A. Ebadian, Florida International University, (305) 348-3585

High-Level Waste Tanks

Waste Retrieval

Ultrasonic Sensors for *In Situ* Monitoring of Physical Properties

Project objectives

The objective of this project is to develop ultrasonic sensors for *in situ* monitoring of physical properties of radioactive tank waste, which include density, viscosity, percent solid concentration, and level. In FY98, the project will focus on development and demonstration of an ultrasonic sensor for measuring percent solids in a waste-slurry transport line. The sensor will be tested at Oak Ridge National Laboratory (ORNL) hot-test facility. The developed sensor that can be used for continuous, in-line monitoring of waste slurry is important to the safe operation of tank-waste transport.

Major milestones

- A topical report on solid concentration measurement; due 3/31/98. This milestone was not completed because we are repeating some of the laboratory tests and exploring a dual-frequency approach for improving measurement sensitivity. The expected completion date is 5/31/98.
- Design and fabrication of a prototype instrument: (1) complete the development of control electronics and software and (2) deliver the prototype instrument to ORNL. Both milestones are due 5/31/98.
- Calibration tests at ORNL hot-test facility: (1) begin hot tests, due 8/3/98 and (2) complete a final report of solid-concentration instrument, due 12/31/98.

Significant events

We presented this project at the CMST-CP Annual Review Meeting. In the meeting, we discussed with David Cremer of SEA, Inc., potential collaboration in developing a fluid level sensor for *in situ* level monitoring of high-level tank waste. We proposed to develop an ultrasonic level sensor based on the solid-concentration sensor being developed in this fiscal year. A joint proposal will be developed.

Accomplishments and technical progress

We received from Tom Hylton of ORNL the flange specifications and other requirements for the instrument spool piece this month. The design of the instrument spool piece was finalized.

We continued the stability test for the control electronics and the temperature calibration for the sensors. Acoustic characteristics in sodium hydroxide solutions are being examined.

Assessment of current status

Both project cost and schedule are as planned. However, we have received only half of the FY98 funding.

Plans for the next two months

In May, we will complete fabrication and laboratory testing of the prototype instrument. The instrument spool piece will be delivered to ORNL.

In June, in collaboration with ORNL, we will install the instrument spool piece at the ORNL hot-test facility and conduct the instrument performance evaluation and calibration.

PI: Shuh-Haw Sheen, Argonne National Laboratory, (630) 252-7502

Comparative Testing of Pipeline Slurry Monitors

Project objectives

This task is to demonstrate and test various state-of-the art instruments for monitoring the transport properties of slurries. The instruments that will be evaluated include some that are commercially available and some that are newly developed under the sponsorship of the CMST-CP. The selected instruments will be installed and tested with radioactive slurries to determine their ability to monitor the transport properties on-line and in real time. If the transport properties are not in the correct range, the pipeline could plug with suspended solids during the transfer. If a pipeline plug occurs that is not resolvable by conventional methods (e.g., back-flushing with water), the site must typically exercise one of two options: (1) locating, excising, and replacing the plugged portion(s) of the pipeline, and (2) abandoning the pipeline and building a new one. The ability to determine the transport properties on-line and in real time is important because the slurry properties are reported continuously, and operators can respond quickly if the monitors indicate a potential pipeline plugging problem.

Major milestones

- Complete design for instrument test system; due 12/31/97. Design specification is complete, as scheduled.
- Complete test plan; due 1/31/98. The test plan was completed and approved by the CMST-CP project facilitator as scheduled.

- Complete test system fabrication; due 5/30/98. This milestone is delayed and is forecast for completion by 7/6/98. The fabrication of the test system was awarded. The vendor quoted a delivery date of July 6. The delay in schedule is because the original bids were higher than expected, which required modifications to the fabrication specifications to reduce the price. The modifications resulted in the need to have the vendors rebid the fabrication cost. Also, the fabrication schedule quoted by the vendor is longer than that assumed for the original schedule. Although the vendor will not commit to an earlier delivery schedule, he has indicated that he will try to deliver the unit early.
- Begin testing slurry monitors with radioactive slurry; due 8/3/98. This milestone is on schedule. The fabrication of the test system was awarded. The system is scheduled to be delivered by July 6.
- Complete slurry monitoring testing and submit letter report; due 9/30/98. This milestone is on schedule. The fabrication of the test system was awarded. The system is scheduled to be delivered by July 6.

Accomplishments and technical progress

Revised bids were received for fabricating the slurry monitoring test system in which the slurry monitoring instruments will be installed for evaluation. By changing the construction material from stainless steel to carbon steel, the cost of fabricating the system was reduced to a price that was close to the original estimated cost for the system. The subcontract for fabricating the system was awarded to Alloy Fabrication in Clinton, Tennessee. The subcontractor has quoted a delivery schedule of July 6. The project's planned delivery date was May 29. The schedule delay occurred because of a delay in awarding the subcontract because of rebidding the fabrication of the system and because the vendor is estimating a longer schedule to build the system than we originally planned. The delivery schedule was discussed with the vendor. The vendor is not willing to revise the delivery date, but he is willing to try to complete the fabrication of the system early.

Assessment of current status

When the system was designed to be built with stainless steel, it was planned that Oak Ridge National Laboratory (ORNL) would supply the valves in the test system to the fabricating vendor. These valves (also stainless steel construction) were going to be obtained from an existing supply at ORNL and would be obtained at a lower cost than purchasing new stainless steel valves. Because the system construction changed to carbon steel, the purchase of the stainless steel valves was deferred, and the fabricating vendor was requested to supply the valves (carbon steel) for the test system. The delay in receiving the test system is also contributing to the schedule variance.

Plans for the next two months

Activities for the next two months include ordering support equipment for the test loop (e.g., computers, software, hardware), fabrication of the test system, and preparation of documentation (e.g., procedures) for operating the system.

The planned delivery of the test system on July 6 allows four weeks to install and setup the test system before beginning radioactive operations by August 3. We are working with the Gunite and Associated Tanks project to facilitate the installation and various utility connections to the test system.

PI: Tom Hylton, Oak Ridge National Laboratory, (423) 576-2225

Waste Sampling/Analysis

Integrated Raman pOH Sensor for In-Tank Monitoring

Project objectives

The objectives of this project are to design, assemble, and deploy an *in situ* monitor for corrosive species in DOE's large-scale waste tanks. The base phase of the program includes a series of tests designed to establish the feasibility of a fiber-optic Raman sensor to detect anions of interest at concentrations typically found in the tanks. Materials proposed for use in the tanks will be evaluated under conditions of elevated pH, temperature, and radiation. Lastly, the requirements and preliminary design for a liquid sampling system compatible with both the Raman probe and existing tank deployment hardware will be developed in the base program. Follow-on work will include assembly of a fully functional instrument and deployment in real waste tanks.

Major milestones

- Raman feasibility tests; due 3/31/98. The feasibility study was completed as scheduled.
- Materials testing; due 6/30/98. This milestone is 50% completed.
- In-tanks probe design; due 9/30/98. This milestone is 10% completed.

Significant events

There is a change of PI on this project. Dr. Job Bello is replacing Dr. John Haas. Dr. Haas attended the CMST-CP Annual Review Meeting and presented the project status.

Accomplishments and technical progress

Compatibility tests of the materials that will be used in the Raman probe started. An endurance test was performed in a 10 M NaOH bath on various probe components such as stainless steel rod, epoxy, fiber-optic cable, quartz window, and sapphire window. The components were immersed in the caustic solution for ~10 months. Results show no degradation of the components under this condition. Radiation and temperature testing of the probe components will follow. In-tank probe design also commenced.

Assessment of current status

Work remains on schedule without any major issues.

Plans for the next two months

The major objective for the next two months is to complete the materials testing of the Raman probe components and to finalize the Raman probe design that will be used in the tanks. A meeting between EIC, Savannah River Site, the Tank Focus Area, and CMST-CP personnel is also being planned for the first week of June to discuss requirements and details of the Raman/sampling chamber design of the probe.

PI: Job Bello, EIC Inc., (781) 769-9450

Field Raman Spectrograph for Environmental Analysis

Project objectives

This project is to design, fabricate, field test, and evaluate a field-hardened Raman Spectrograph/Monochrometer System including its analytical protocols. The technical goal of this program is a field-portable, fiber-optic Raman spectrograph that can be used to obtain “chemical fingerprints” of hazardous waste in storage tanks and of concentrated and dilute environmental contaminants in soil and water. The Phase 2 objectives are to provide an improved instrument that can be used for an evaluation by DOE field personnel and other contractors involved in environmental remediation efforts. An enhanced instrument software package for improved data collection and signal processing will be developed.

Major milestones

- Spectrograph development and testing
- Demonstration site selection
- Cone penetrometer testing at SRS
- Field testing assessment and modification/software D
- Cone penetrometer evaluation at SRS
- Hanford demonstration

Accomplishments and technical progress

The final technical report, prepared by EIC, was received by the FETC and will be reviewed by the technical staff and Focus Area in terms of its technical merits and success criteria in accordance with the statement of work. Raman spectrograph developed by the contractor will be used for testing and demonstration at the Savannah River Site (SRS) during the first week of June. SRS has shown a great interest in using this technology for future deployment after the successful demonstration as planned in June.

PI: Michael Carrabba, EIC Laboratories, (617) 769-9450

FETC COR: Jagdish Malhotra, (304) 285-4053

Process Monitoring

Development of Process Monitors for Cesium-137 Column Breakthrough

Project objectives

This project will optimize an inexpensive, highly reliable, near real-time monitoring system for the specific detection of ^{137}Cs in the effluent from an ion exchange column. A matched pair of radiation detectors will be used to monitor activity in the effluent stream at two locations separated by a short span of time.

Major milestones

Complete system software modifications; due 5/31/98. This milestone involves choosing spectral deconvolution code, and writing and installing data output and process control codes. Progress is on schedule.

Accomplishments and technical progress

Final engineering and assembly of the monitor is in progress. The computer was reconfigured from desktop to tower. Software modifications are being made to provide additional output information required by Oak Ridge National Laboratory (ORNL). Additional software is being written to accommodate feedback logic signals provided by ORNL. Dedicated power conditioners were ordered. Signal and control cabling requirements for installation in the conduit connecting the process building and the building that houses the control room were transmitted to ORNL. The temperature stabilization system was received, but failed to meet stability specifications and was returned to the manufacturer for replacement. The Multichannel Analyzer control software module was written and successfully passed preliminary testing. The component parts for the collimator were received. Design and fabrication of the

stainless steel mold for the passive lead detector shield is in progress. The system architecture has been diagrammed (see figure 1). The system is on schedule for completion by the end of next month.

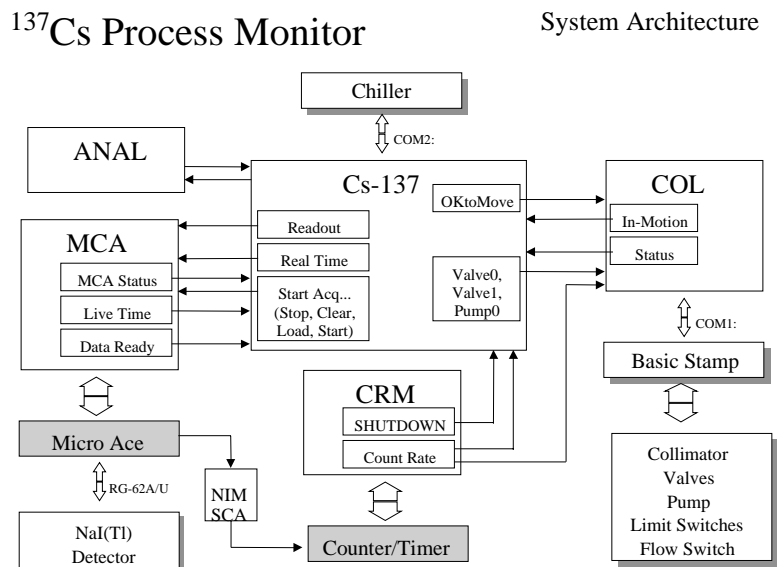


Figure 1. System architecture diagram.

Assessment of current status

There is no significant cost variance. The schedule variance of 6% will not affect the timely completion of tasks.

Plans for the next two months

Efforts will concentrate on completion of the engineering, fabrication, assembly, and testing of the monitor to be installed at ORNL.

PI: Ron Brodzinski, Pacific Northwest National Laboratory, (509) 376-3529

Development of a Magnetic Resonance Monitor for Technetium-99 Column Breakthrough

Project objectives

The objectives of this project are to develop and implement a real-time, on-line monitoring system for Technetium-99. This system will be based on magnetic

resonance spectroscopy of the ^{99}Tc nucleus. The sensor will be based on Argonne National Laboratory's (ANL) on-line, flow-through magnetic resonance sensor technology that is being developed for on-line sensing and quantification of organic components. The spectrometer will incorporate a permanent magnet, a highly miniaturized electronic package, an intelligent operating system, and a remote setup and operation panel; it will be completely enclosed in a short 19-inch NEMA 4 instrument rack.

This technique will provide a real-time (milliseconds), nonradiometric sensing method that is capable of operating in a high radiation environment, with immunity to contaminants, on high pH solutions, and in high dissolved salt levels. In addition to the areas of tank waste processing, this sensor system will prove valuable in other waste processing technologies. The specific thrust of this immediate work is to focus on the ^{99}Tc waste cleanup needs associated with both ion exchange and electrolytic reduction processes being developed by the privatization partners. Additionally, this work benefits the DOE for continuous, on-line monitoring of ^{23}Na and ^{99}Tc from waste tanks.

Major milestones

- Complete modification of the ANL controller; due 07/15/98. Physical modifications to the ANL ^{99}Tc sensor system were delayed because of difficulties in working out the chemical details of the ^{99}Tc oxidation chemistry. However, we are back on track by demonstrating the oxidation chemistry in the nuclear magnetic resonance (NMR) system. Subsequently, we are anticipating on schedule completion of this milestone.
- Complete system deployment plan; due 07/15/98. This milestone has been delayed because of the delay in the previous milestone.

Significant events

This month, we were successful in performing a series of reduction and oxidation studies on technetium-containing species. These redox studies significantly advance the understanding of the kinetics and mechanisms of ^{99}Tc as relevant to the oxidation studies performed at Los Alamos National Laboratory and Pacific Northwest National Laboratory. Specific studies demonstrated the ability to titrate pertechnetate with a stannous chloride reducing agent, followed by oxidation of the reduced Tc species to pertechnetate with either peroxodisulfate or cerium sulfate. These reactions were monitored using the 2 Tesla on-line NMR spectrometer.

Accomplishments and technical progress

Given the discovery of the multiple ^{99}Tc oxidation states, the complex chemistry and inhomogeneities of the individual tanks, and the large number of tanks to be dealt with, it became necessary to fully oxidize the technetium species to pertechnetate to perform a quantitative analysis on-line. The success this month in monitoring the oxidations and

following the kinetics of oxidation reactions is vital for developing a useful monitoring system.

Assessment of current status

There are no outstanding cost variances.

Plans for the next two months

We plan to continue the oxidation experiments to measure kinetic parameters at several temperatures. Furthermore, armed with the reaction conditions, we will design an elevated temperature reaction and pumping system. This system will be integrated into the spectrometer and serve as an oxidation chamber just prior to the NMR analysis.

PI: Stephen Dieckman, Argonne National Laboratory, (630) 252-5628

Mixed Wastes

Pre-Processing Characterization/Monitoring

Waste Inspection Tomography

Project objectives

This project has developed a system, Waste Inspection Tomography (WIT), that can be brought to the waste site to perform tomographic characterization of nuclear waste drums using a multimodality approach. In the WIT system, high energy computed tomography (CT), emission tomography (ECT, or SPECT for single photon ECT), and emission spectroscopy for nondestructive assay (NDA) are integrated on a mobile trailer. WIT will safely and cost-effectively identify contents, provide two and three-dimensional information about contents, locate isotope emissions, and identify an emitting isotope species. The WIT system is coupled with neutron interrogation methods, the Active Passive Neutron Examination Assay (APNEA) system, under a separate DOE contract.

The current project objective is to increase the WIT assay throughput such that the system is commercially deployable. Specifically, the goal is to increase the throughput (or speed up the time required for the completion of assay and data collection) for WIT NDA from 24 hours per drum to less than one hour per drum. Additionally, a bar code reader will be added to WIT for identification of waste drums.

Major milestones

Phase 3 upgrades

- Design/fabricate—1/98-6/98
- Assembly—7/98
- Software development—1/98-7/98
- Field testing at Lawrence Livermore National Laboratory (LLNL)—8/98-9/98
- Final report—9/98

Significant events

Bio-Imaging Research (BIR) is involved in upgrading the WIT system hardware and software. High Purity Germanium (HPGe) detection systems are on order from EG&G ORTEC. Six new 10 mCi radioisotopic transmission sources were ordered in April based on LLNL recommendations from Isotope Products. Both the six detectors and six sources are scheduled to arrive at BIR in June in time for July assembly. The six sources shall be NIST-traceable to allow for direct self-calibration for each of the six HPGe detectors.

Accomplishments and technical progress

Mechanical layout drawings for detector mounting, collimation, shielding, and mechanical drive mechanisms are still in progress. April included detailed drawings of the detector collimators, lead and Tungsten shielding, elevation frames, dewar support frames, base frame, and indexing frame. The collimators for the six detectors are modular for removal (to maintain the trailer weight under 55,000 pounds at the rear axles) using the trailer's overhead gantry crane because they will weigh in excess of 800 pounds as a one-piece assembly. The specification of drive screws, and motors, will be completed in May. The design of the source holders (isotopic cameras) will begin and finish in May now that the isotopic transmission sources are selected. The intent is to complete the mechanical designs in May for June fabrications and July assembly (a tight schedule).

Software design documents were prepared and reviewed for BIR and LLNL software development tasks for motion control, the new graphical user interface, the data collection, reconstruction, and spectroscopy as incorporated into the BIR ACTIS operating system software for WIT collimated gamma scan (CGS) and active and passive computed tomography (A&PCT). Some of these documents will be on the WIT trailer at the Nevada Test Site (NTS) for the Carlsbad Area Office (CAO) audit in June for auditor review as an indication of BIR compliance with NQA-1 and American Society of Mechanical Engineers software quality assurance requirements.

LLNL progress for April; reported by Pat Roberson, LLNL program manager:

In April, the Livermore team worked with David T. Nisius, a Nuclear Physicist from BIR. Livermore personnel introduced him to the A&PCT technology and described Livermore's function in the project. Most of the time was spent covering the methods of isotopic analysis related to TRU waste. Considerable time was also spent covering software codes and how they will be integrated. This software description included preprocessing, isotopic analysis and reconstruction codes. Livermore personnel have been preparing for a project review at LLNL that will include team members from LLNL, BIR, and reviewers from Idaho National Engineering and Environmental Laboratory and Oak Ridge. The review will be held May 27 and 28.

Reconstruction code. Livermore continued work on the documentation for the new A&PCT CCG algorithm. Livermore personnel are studying the noise model in the CCG algorithm to see if it has an effect on the system bias. There are some critical parameters in the algorithm that must be analyzed for sensitivity and evaluated for accuracy to provide the most robust and precise results. We will continue to evaluate these parameters through the next month.

Isotopic analysis. Livermore continued to develop the isotopic analysis code by adding new features and enhancing the existing fitting routines. Effort was spent on testing and debugging the code on different sample types. Most of the effort was devoted to

developing different methods that are required for fitting samples that have high ^{241}Am and low ^{239}Pu concentrations. Nearly all of the first cut fitting routines assumed high ^{239}Pu concentrations. This work is proceeding; but is non-trivial because the magnitude of the peaks available change dramatically for different sample types. In May, Livermore will continue to develop the type and content of the different outputs generated by the isotopic analysis code.

Data acquisition. Livermore delivered a document entitled “Active Source Requirements for Assay of Sludge Drums on the BIR WIT System” that was written by G. Patrick Roberson and David C. Camp. The A&PCT active source requirements are highly dependent on the attenuation properties of the waste matrix within the drum. One of the most highly attenuating waste matrices is sludge. This document describes the results from the WIT system assay of real TRU sludge drums. Information gained from this experience has demonstrated the requirements necessary for the active imaging of sludge drums within a reasonable amount of time. A simulation was performed to determine optimum requirements and parameters. These results were used to develop options for assaying the sludge drums with maximum throughput.

Plans for the next two months

In May, BIR will complete the mechanical designs and have all mechanical hardware on order for late June and July delivery. Software development from both BIR and LLNL will be ongoing during the next two months. BIR will have a design review at LLNL the week of May 25 to review LLNL progress and to develop test plans for known drum tests, blind drum tests, and quality assurance program plan (QAPP) quality assurance objectives (QAO) tests to assure that the new multi-detector A&PCT system will meet all upgrade objectives.

PI: Richard Bernardi, Bio-Imaging Research, (847) 634-6425

FETC COR: Steve Cooke, (304) 285-5437

Nondestructive Examination and Assay of Drums Containing Transuranic Waste

Project objectives

This project will integrate or superposition data from X-ray nondestructive examination (NDE), gamma nondestructive assay (NDA), and neutron NDA for the characterization of transuranic (TRU) waste drums. The Waste Inspection Tomography (WIT) system provides X-ray NDE and Gamma NDA; the Active and Passive Neutron Examination and Assay (APNEA) system provides neutron NDA.

Major milestones

- Phase 1: demonstration of WIT/APNEA data fusion, completed 8/96
- Phase 2:
 - collection of WIT APNEA data at INEEL, completed 2/97
 - completion of WIT data analysis, completed 3/97
 - completion of APNEA data analysis, completed 2/98
 - completion of WIT/APNEA data integration, expected 4/98 and 5/98
 - completion of final report, expected 5/98

Significant events

APNEA assay results were integrated with results from the WIT active and passive computed tomography (A&PCT) for four drums.

Accomplishments and technical progress

During April, Bio-Imaging Research (BIR) integrated four drums of the WIT and APNEA data collected at Idaho National Engineering and Environmental Laboratory (INEEL) in February 1997. This image data fusion will be presented in the final project report, which will be prepared in May. A generalized summary of results consists of the following:

- Relative to a vertical distribution of activity, both the A&PCT and APNEA have general correlation of results on the four drums presented.
- Relative to slice-by-slice intercomparisons, A&PCT indications show planar distribution of activity, while APNEA shows planar indications with some voxels having zero activity indication that differs from A&PCT results.

The published Rapid Commercialization Initiatives (RCI) results for both WIT and APNEA relating to all eight drums of data collected indicate that BIR has passed on seven of the eight drums (for NDA bias and precision), while the eighth drum is still waiting for rad chemistry results to determine if WIT passed. The APNEA system passed on two of the eight drums for bias and precision.

Plans for the next two months

The draft final report is expected in May.

PI: Richard Bernardi, Bio-Imaging Research, (847) 634-6425

FETC COR: Steve Cooke, (304) 285-5437

Project objectives

This activity is designed to perform a blind (sample) determination of existing mobile nondestructive assay technology (technology using either gamma spectroscopy or neutron counting). Through appropriate selection of test samples, which are composed of mocked surrogates containing known radiological sources and actual rocky flats transuranic (TRU) waste, the project will provide a detailed understanding of each technology implementation, waste stream applicability of each technology, and sources of errors in software data reduction algorithms. This information will be used to guide EM-30 efforts to dispose of waste at small quantity sites and low volume sites where fixed assay capability is not needed. Further, the information collected by this performance evaluation will be examined by a panel of experts in cooperation with the laboratory or industry partners to understand technology limitations and where technology development efforts should be focused.

Accomplishments and technical progress

The Los Alamos Tomographic Gamma Scanner (TGS), the final assay system to be evaluated, completed its six-week assay period this month. The TGS system was able to assay 27 of the 32 test samples. All of the waste surrogate sample drums were analyzed. All test results were received, and surrogate sample results were scored.

TGS is limited to the amount of plutonium it can detect and had a limit of detection of about 2 grams of total plutonium. Of the 11 surrogates, seven exceeded the minimum detection limit. TGS was able to correctly analyze all seven.

Current project efforts are focused on returning the test facility, Building 634 at the Radioactive Waste Management Complex, to its pre-demonstration status. These activities will be completed by late May.

A report detailing the results of each system evaluated in the demonstration is being prepared. This report will consider each system on a waste stream by waste stream basis. The accuracy and precision of results will be discussed, and applicability for waste form assay as a function of system configuration will be presented.

A companion report, sponsored by the Mixed Waste Focus Area, will examine the results for both surrogate and actual waste forms. This analysis will evaluate existence of technology gaps and topics for future technology development. Based on our preliminary analysis of the surrogate results, we anticipate that few gaps will be identified related to actual instrument development. Most of the technology gaps will be associated with analysis software improvements and improved translation of density information into bias corrections.

As planned, this effort will be completed by the middle of June.

PI: Mike McIlwain, Idaho National Engineering and Environmental Laboratory,
(208) 526-8130

Waste Process Monitoring and Controls

Real-Time Plutonium Monitoring

Project objectives

The project is developing an on-line, real-time monitor for measuring the concentrations of americium and curium in a molten glass stream produced by the vitrification of tank waste at Savannah River. The presence of the monitor will reduce the number of hazardous and expensive samplings and off-line analyses that will have to be done during the vitrification. During FY98, the project is producing a prototype monitor that will be demonstrated at Savannah River late in the fiscal year. The demonstration will familiarize the staff of the Am-Cm Stabilization Project at Savannah River with the monitor and begin the process of integrating the monitor into their process-line design.

Major milestones

- Build real-time, fiber-optic interfaced monitor; due 5/30/98. Support equipment (e.g., control computer, signal processing lock-in amplifier) was received in previous months. The acousto-optic tunable filter (AOTF) crystal for the spectrometer arrived in April. With the crystal in hand, we began modifying the control software used last year so that it will drive the new crystal. The optical design of the spectrometer can be completed now that we have the crystal for testing. After the design is completed, plans will be submitted to the shop for construction. We will then assemble and test the complete monitor. The delay in receiving the crystal put us a few weeks behind, so it is likely that the monitor will not be completed until mid June. This delay should not affect the overall project schedule.
- Demonstrate new transient infrared spectrometer (TIRS) monitor. After completion of the previous milestone, the monitor will be shipped to Savannah River. The demonstration is tentatively scheduled for July. The exact date will depend on how best to include the monitor in the testing schedule of the Am-Cm Stabilization Project. The glass stream will contain a mixture of metal oxides prepared by Savannah River as a nonradioactive surrogate for the tank waste, with erbium substituting for americium and curium.

Significant events

On April 8, the PI gave a presentation at the CMST-CP Annual Review Meeting describing the present status of the project and our plans for the upcoming year.

The paper "On-Line Composition Analysis in Molten Glass during Waste Vitrification" discussing project results was presented in New Orleans at Pittcon '98 in March.

A Savannah River engineer rebuilding a melter recently inquired about the monitor technology after speaking to our FY97 collaborators. We provided him with

information, including a copy of the Pittcon paper, and we invited him to observe the demonstration of the new TIRS monitor.

In March, we received glass samples from our Savannah River collaborators that will be used to test the completed monitor. We examined the glasses using a standard lab spectrometer and found that their waste surrogate provides many monitorable peaks including those from erbium oxide, their surrogate for americium and curium.

Accomplishments and technical progress

We received the AOTF crystal for the spectrometer in April. We tested it to make sure it meets all necessary specifications. Final work on the optical and physical design for the monitor is being conducted now that we have the crystal in hand for design testing. Final plans will be submitted to the machine shop in May.

Assessment of current status

The delay in receiving the crystal pushed back our schedule slightly so that construction of the monitor may not be completed until mid June, after the planned May 30 completion date. This delay will not affect the overall project progress and does not constitute a schedule variance greater than 10%. Cumulative costs for the fiscal year are within 10% of projection.

Plans for the next two months

Completed designs for monitor parts will be submitted to the machine shop in May. The parts will then be assembled into a complete monitor in late May or early June. The monitor will be thoroughly tested in the lab in June. The monitor will then be shipped to Savannah River for the on-site demonstration tentatively scheduled for July.

PI: John McClelland, Ames Laboratory, (515) 294-7948

Offgas and Effluent Monitoring

Demonstration of Emerging Continuous Emissions Monitoring Technologies

Project objectives

The purpose of this task is to accelerate the commercial availability of continuous emissions monitors (CEMs) that meet EPA Performance Specifications and the Technical Requirements specified by the Mixed Waste Focus Area (MWFA). The work is to be conducted in collaboration with the DOE EM (CMST-CP and MWFA), EPA (OSW, OAQPS, and ORD), and other federal agencies participating in the work of the Interagency CEM Coordination Committee. The emissions of concern are

particulate matter (PM), mercury, multi-metals, organics, dioxins/furans, and radionuclides.

This task will provide technical and implementation support as required to (1) accelerate the commercial availability of CEMs as stated and (2) address documented Working Group goals approved by MWFA and CMST-CP program managers. According to current Working Group goals, continuous emissions monitoring of hazardous and mixed waste thermal treatment processes is desired for verification of emission compliance, process control, and public safety perception. The proposed EPA Maximum Achievable Control Technology (MACT) rule will likely include limits on mercury emissions. DOE incinerators need to have a reliable method of measuring and monitoring their stack emissions for mercury. CEM technology, once proven reliable and accurate, will fulfill this need.

Major milestones

- Briefing on PM and Hg CEM tests; due 4/1/98 and completed 4/15/98. This milestone involved preparing and delivering a summary briefing on the joint EPA/DOE extended duration tests of particulate matter and mercury CEMs to the Interagency CEM Technology Development Coordination Committee and Working Group.
- Hg CEM test plan; due 6/15/98. This milestone involves preparing and delivering a draft test plan for testing one or more Hg CEMs at an operating DOE hazardous waste treatment facility. The test plan will include identification of committed test CEMs and the test site.
- Complete Hg CEM testing; due 8/1/98. Under this milestone, testing of one or more Hg CEMs at an operating DOE hazardous waste treatment facility will be conducted.
- Technology performance report; due 9/30/98. This milestone involves completion and delivery of a Technology Performance Report (TPR) describing the testing and observed performance of the Hg CEM(s).
- Update of CEM Technology Deployment (TD) Strategy Document; due 9/30/98. This milestone is to deliver an updated CEM TD Strategy document to the CMST-CP and the MWFA, including sections on mercury, multi-metals, dioxins and furans, and radionuclides.

Significant events

Revision to the technical task plan (TTP) preapproved by the Focus Area CEM leads was submitted to the DOE Savannah River Operations Office for approval and transmittal to DOE Headquarters and the Focus Area headquarters personnel.

Accomplishments and technical progress

This TTP was completely rescoped. The program execution guidance (PEG) and TTP, Rev. 1, reflect the change in scope to test one mercury CEM during the remainder of this year. Significant issues are selection of the DOE-operated incinerator site for testing and selection of the Hg CEM to be tested. Discussions are in progress with the DOE-owned incinerator facility operators and managers to determine which site is most suitable for testing. A test plan must be drafted by June 15 to meet the PEG milestone. The plan is being developed, and selection criteria to determine which CEM to test are being finalized.

Assessment of current status

The cost and schedule variances are less than 10%.

PI: Richard Hane, Savannah River Technology Center, (803) 725-5811

Development of a Multielement Metal Continuous Emissions Monitor

Project objectives

This project will develop a spectrometer system based on acousto-optic tunable filter (AOTF) and high resolution echelle grating technologies. The spectrometer and advanced user interface are being assembled for use as a compact, high-resolution detector in inductively coupled plasma atomic emission spectrometry (ICPAES). The High Resolution Interferometric Spectrometer (HiRIS) system will be combined with a portable air-plasma ICPAES system developed by collaborators at Mississippi State University (MSU) for compliance monitoring of heavy metal contaminants in stack emissions, as well as for monitoring of actinide materials. The development of continuous emission monitoring will aid in compliance with proposed EPA regulations by waste combustion facilities.

Major milestones

- Complete upgrade, integration, and testing of array-based spectrometer with air-ICPAES at DIAL; due 7/31/98. Progress is on track.
- Complete alpha-emitter monitoring test and issue report; due 9/30/98. Progress is on track.

Significant events

The PI participated in the CMST-CP Annual Review Meeting. Following the presentation, contacts were made with other PIs in the program regarding other potential applications for the high resolution spectrometer system.

Discussions are continuing with scientists from Savannah River Technology Center regarding the application of this technology to monitoring spent nuclear fuel processing.

We hosted a visit by one of these scientists and discussed the capabilities of the technology. Another visit is being planned.

Accomplishments and technical progress

Tests of the bench-scale prototype spectrometer were completed. Planning continues on assembly of the field prototype to be used in the planned tests. The grating ordered in December should arrive in May. Arrangements were made for our collaborator at Diagnostic Instrumentation and Analysis Laboratory (DIAL)/MSU to provide the charge coupled device (CCD) array detector to replace our photodiode array detector in the field prototype. It should also arrive during May. Incorporation of this component will include modification of our extensive “user-friendly” graphical interface and control system to make the choice of detection system transparent to the user.

Assessment of current status

All milestones are on schedule with no schedule variances. The cost variance is due to delays in purchasing necessary components including an AOTF and detector. These components are being borrowed and evaluated before committing funds to these purchases. The delay in these purchases will not impact milestone status or technical progress.

Plans for the next two months

During May, several components for the field prototype will arrive, and we will begin assembly of that unit. We will also perform the software modifications necessary to incorporate the CCD detector. We will order the AOTF during May, having completed our evaluation of the borrowed system.

During June, we plan to evaluate the performance of the field prototype with respect to resolution, sensitivity, and stability. The system will be prepared for our July test at MSU.

PI: David Baldwin, Ames Laboratory, (515) 294-2069, dbaldwin@ameslab.gov

Metal Emissions Monitor for DOE Mixed Waste Thermal Treatment

Project objectives

The objective of this project is to develop and demonstrate an instrument using laser-induced breakdown spectroscopy (LIBS) as a continuous monitor to measure metal emissions from offgas of thermal treatment units. The project will address several important issues for the instrument, including sensitivity (desire ppb detection of As, Be, Cd, Cr, Hg, and Pb), accuracy, durability, and reliability. Current tasks include construction of a second-generation instrument to address the above issues and performance validation at an acceptable thermal treatment facility.

Major milestones

Second-generation instrument; due 5/31/98. This milestone is on schedule.

Performance testing; due 8-31-98. This milestone is on schedule.

Significant events

Discussed future field testing of the metals monitor at the Toxic Substances Control Act (TSCA) Incinerator at the DOE K-25 site, including the additional LIBS-based discrete particle analysis capabilities that are being developed as part of the instrument package.

Accomplishments and technical progress

The technical specifications for the new spectrometer/detector system designed for the second-generation instrument were acceptable to the component supplier, and an expedited order was placed. The new spectrometer/detector will provide a 300-nm spectral bandwidth, enabling monitoring of all targeted metals with each laser pulse. This provides a significant improvement over the current prototype system, which enables monitoring of a given metal species approximately 25% of the time because of its limited spectral bandwidth.

Assessment of current status

All tasks and milestones are on schedule. Spending is less than anticipated because of recent field tests that used additional leveraged program funds. Spending will increase in May and June as the second-generation instrument is assembled and interfaced to the system software package, and during the anticipated July performance validation.

Plans for the next two months

A field demonstration of the current prototype LIBS monitor is scheduled for May using leveraged program dollars from the DOE Office of Fossil Energy. The tests will be on emissions sources in the areas of oil and natural gas production, namely engines and boilers, and are being conducted in partnership with Chevron USA.

Candidate sites will be evaluated in May and early June for the scheduled performance validation of the completed second-generation instrument. The goal is to locate and confirm a suitable site as early as possible.

PI: David Hahn, Sandia National Laboratories, (510) 294-3337, dwhahn@sandia.gov

Disposition of Facilities (D&D)

Metals and Pipes

Portable X-Ray, K-Edge Heavy Metal Detector

Project objectives

The purpose of this work is to support deactivation and decommissioning (D&D) activities through development of improved nondestructive assay (NDA) techniques for detecting and quantifying uranium, plutonium, mercury, and other heavy metals located inside sealed containers or processing equipment. The approach to this problem is based on observing the K-edge absorption transition in X-ray transmission measurements. This provides an accurate, noninvasive measurement of heavy metals, with the benefits of improved efficiency and safety in D&D operations.

Major milestones

- Documentation of customer commitment, and specifications for a Large-Scale Demonstration Project (LSDP); due 3/31/98. The projected completion date is 8/31/98. Under this milestone, a site will be selected for application of the K-edge technology in a D&D Focus Area LSDP. A report will be submitted to DOE Headquarters indicating customer commitment and plans for the demonstration. This milestone is delayed because the D&D Focus Area was delayed in establishing contracts for new LSDPs. Now that contracts are in place, we have made contacts at Los Alamos National Laboratory, Idaho National Engineering and Environmental (INEEL), and Savannah River to discuss these upcoming projects and make sure that they are aware of our technology. We are also working with personnel at Ames Laboratory to determine whether K-edge analysis can be of benefit in dealing with legacy thorium contamination in one of the laboratory buildings.
- Operate K-edge detector in D&D Focus Area LSDP; due 8/31/98. Under this milestone, the K-edge system will be operated for an extended period of time as part of a D&D Focus Area LSDP. Personnel at the site will be trained in operation of the equipment and interpretation of the results. This milestone is contingent on completion of the previous milestone.

Significant events

Interest was expressed in using K-edge technology at Rocky Flats Environmental Technology Site (RFETS) in characterizing Pu in pipes and ducts in Building 779. An invitation was extended to visit the site to assess the potential for application of K-edge technology.

Accomplishments and technical progress

The PI attended one of the regular meetings being held at Ames Laboratory to discuss the best approach to deal with thorium legacy contamination from operations in Wilhelm Hall during the 1940s and 1950s. It was concluded that additional characterization will be needed. Areas where K-edge technology could be applied include drain lines and ductwork.

A source of systematic bias in the measurement of Resource Conservation and Recovery Act (RCRA) metals in drums was identified. New results for a Pb calibration drum are within 10% of the expected value.

Assessment of current status

The project schedule is behind because the new D&D Focus Area LSDPs did not begin until March. Now that these contracts are in place, we are talking with the appropriate personnel at the different sites to make sure that the K-edge technology is considered in these projects. This delay is one reason for a large cost variance. The other reason is that a new grad student is not able to start working with us until his visa status is changed. This process is expected to be completed in May. We developed a new spending plan to reflect these changes.

Plans for the next two months

The PI will attend the D&D Focus Area mid-year review to learn more about the new LSDPs and Accelerated Site Technology Deployments and establish better communications with personnel involved in these projects.

We will participate in regular meetings at Ames Laboratory to help determine the best approach for dealing with legacy thorium contamination in Wilhelm Hall.

We will arrange to visit RFETS to tour building 779 to assess the potential for applying K-edge technology in Pu measurements.

Measurements will be completed on a series of drums containing surrogate Hg and Pb contaminated sludge. The results will be communicated to personnel at INEEL for their evaluation of possible follow-up activities.

PI: Joe Gray and Terry Jensen, Ames Laboratory, (515) 294-9745

Facility Characterization

Laser-Induced Fluorescence for EM

Project objectives

The laser-induced fluorescence project has three primary objectives in FY98:

(1) complete the backpack uranium survey tool, (2) deploy the survey tool at DOE sites, and (3) develop methods to extend the applicability of fluorescence detection techniques through the use of “enabling technologies” such as chelates, which can make nonfluorescent metals detectable by fluorescence technology.

The uranium survey tool has progressed to a final configuration that is applicable to many needs, especially in the area of deactivation and decommissioning (D&D). The system will be field tested during FY98. Our goal is to accomplish laser-induced fluorescence imaging (LIFI) screening with regulatory participation, after which we can safely say that LIFI was deployed in the strictest definition. As part of our research into relevant applications, we devised a strategy to increase the utility of the fluorescence-based sensors to include the detection of nonfluorescent contaminants of extreme interest to the DOE, such as cesium. These “enabling technologies” have applicability across several Focus Areas that may need to monitor the leakage of radionuclides in areas where conventional contamination detection approaches will fail. An example would be detecting leakage (contamination) outside storage vessels that contain high levels of radioactive material. Examples include the UF₆ cylinder yards, high level waste transfer lines, tanks, etc.

Major milestones

- Complete backpack system; due 2/28/98. There have been significant delays in component delivery; we expect completion by 5/15/98.
- Deploy backpack to DOE site; due 5/31/98. We are working on deployment schedules for Savannah River Site (SRS) and Oak Ridge; dates are undetermined.
- Demonstrate LIFI data registration; due 7/31/98. This milestone will not be implemented until the above milestones are complete.

Significant events

A meeting was held at Special Technologies Laboratory (STL) with John Gladden from the Savannah River Technical Center. This served as the first planning meeting for the proposed SRS airborne LIFI data acquisition that is scheduled for FY99. SRS and STL are working together to plan the acquisition to achieve several goals, but primarily that the data acquired will be correlated with other remote sensing technologies and the existing database of ground-based measurements. We were informed by the DOE Remote Sensing Laboratory (RSL, Bechtel Nevada) that a DP-sponsored airborne, passive, multi-spectral data collection by RSL is scheduled for this summer at SRS. This collection offers a great opportunity for SRS EM managers to acquire up-to-date, calibrated passive imagery of the site. We made preliminary contact with RSL, and

efforts will be made to include EM site managers in an upcoming planning meeting at SRS. Because the reflectance data to be collected are available in near real-time, site managers will be able to review the data with RSL analysts while they are still on site. We plan to be present to interact with the RSL analysts and site managers during the collection to determine which features observed in the imagery are good candidates for airborne LIFI collection. We also would like to collect ground-based multispectral LIFI at SRS sometime in FY98. This data could be added to the passive data as additional spectral information.

STL scientists visited Larry Stebbins at the Fernald Site in support of the CMST quick-win that aims to deploy LIFI technology in FY98. The deployment involves the examination for uranium contamination on scrap railroad rails cut to five-foot lengths to clear them for free release. STL is procuring materials to create a roller table that allows the rails to move past a LIFI system in a semi-automated fashion.

Accomplishments and technical progress

Backpack LIFI system. Final assembly of the backpack continues. Most components were fit checked, and work is proceeding on the cabling and optics required to project the laser from the handheld portion of the device. Layout of the timing board started, and parts were procured. This board will replace the bread-boarded timing card that currently operates the system. While the board is not required for the completion of the milestone, it is more efficient to fabricate it with the rest of the surface-mount boards. Investigation into the fabrication of a custom cable showed that it would be prudent to fabricate the cable in-house, as this is less expensive than the outside bids received. Cable and connector layouts are complete, and necessary parts were ordered. The system software is running and collects the three frames of data and saves the data to hard drive. We were able to test backpack system software and hardware as a complete unit and confirmed that the new camera, computer, and laser system can see fluorescence and store the images.

Enabling technologies. Thiazol Yellow G was shown to exhibit two luminescent peaks when illuminated at 355 nm. The yellow peak at 580 nm is observed to increase in emission intensity with increasing cesium concentration, while the blue peak at 435 nm is insensitive to cesium ion. Thin-layer chromatography shows that there are two emissive dye components that separate cleanly into a blue and yellow luminescent band on the plate. The yellow component is eluted with water, while the blue component elutes with acetone, allowing for clean separation. The components are being isolated, and the effect of cesium on the individual components is being explored. The separation of the two components in the "as received" dye will increase the fluorescence contrast observed when cesium is added to the solution (and the silicotitanate matrix when it is used as a sequestering material).

Assessment of current status

Both schedule and cost variances are within the threshold.

Plans for the next two months

In the next two months, the LIFI backpack system should be completed and will be ready for evaluation and demonstration.

The Fernald rail project will be further underway. The end result of this work will be a LIFI system installed at Fernald for an extended period for the characterization of rails that have been cleaned.

A second LIFI system (paid for via a cash order), nearly identical to the EM-50 unit, will be delivered to the U.S. Army Corps of Engineers and Ft. Belvoir, Virginia. Their researchers will use the system for identical measurements to those made in this project. This constitutes a technology deployment/transfer to another agency to do work on environmental contaminants and spectral signatures of materials.

PI: John DiBenedetto, Special Technologies Laboratory, (805) 681-2240

Laser-Induced Fluorescence for Heavy Metals in Soils and Plants

Project objectives

This small carryover task is a continuation of the laser-induced fluorescence imaging (LIFI) data take in Poland, which occurred in September 1997. The goals for this year were to complete analysis of the laser-induced fluorescence spectroscopy (LIFS - spectral) and LIFI (imagery) data taken in the field in Poland and to write a summary report.

Major milestones

Complete final report; due 12/31/97. The report was not yet written pending a decision on the LIFI data quality. The completion of this project was delayed because of the unavailability of critical personnel.

Accomplishments and technical progress

The spectral data analysis (LIFS data) has been complete for some time. We have made a preliminary examination of the imagery data (LIFI) and decided that further analysis would not be cost effective. One purpose for pursuing LIFI analysis would be to compare the information quality gathered from LIFI compared to LIFS, and another would be to examine intra- and inter-leaf fluorescence variability. However, potential gains would not justify the time spent.

Assessment of current status

Both cost and schedule variances are within the threshold.

Plan for the next two months

We plan to complete a short summary report.

PI: John DiBenedetto, Special Technologies Laboratory, (805) 681-2240

Environmental Remote Sensing for Monitoring Plant Health (EPCOT)

Project objectives

The long-term goal of this project is to develop methodology and hardware to detect subsurface contamination at DOE sites by means of remote monitoring of signatures from vegetation overgrowth. This requires both controlled laboratory studies of stressed plants, and development, customizing, and testing (first in the laboratory, then at actual DOE field sites) of hardware to remotely detect the appropriate optical signatures.

For FY98, we are making detailed optical response measurements (both reflectance and laser-induced fluorescence) on controlled, stressed populations of plants. This data will be supplemented by information collected on the same populations by other researchers cooperating with us and using different types of instrumentation. Study species include a basic monocot, wheat, and dicot, bean, (both of which are also of great interest to the agricultural community), as well as bahia grass and loblolly pine, which are plants found on DOE sites. Measurements this year will be made by hand, by a robot outfitted with automated, passive sensors for large statistical sampling, by the laser-induced fluorescence imaging (LIFI)/ laser-induced fluorescence spectroscopy (LIFS) system developed at Special Technologies Laboratory (STL), and by equipment developed by cooperating researchers from both government and academia. These measurements will be made primarily in the laboratory, but planning has begun for field measurements at a DOE site, probably Savannah River.

Remote monitoring of vegetation will be valuable as a means for change detection, for detection of localized contamination in soil or water, for monitoring the integrity of presumably contained sites, for demonstration of the results at remediated sites, and for general site stewardship. A few examples of Site Technology Coordination Group (STCG) needs include SR-3025 (Savannah River Site, monitoring integrity of contained waste sites), AL-07-09-03-SC (UMTRA-biointrusion), AL-07-01-01-SC (HE, Ba), AL-07-06-01-SC (Cr), and NV-18-9801-05 (contaminant uptake).

Major milestones

- Complete Zn stress measurements on beans; due 8/30/98. Measurements were completed 2/18/98; the report was completed 3/10/98.
- Bahia grass baseline and stress measurements; due 9/30/98. Measurements are in progress and on schedule.

- Two data takes with portable LIF system; due 9/30/98. This milestone is on schedule and approximately 50% complete; one joint data take was completed (3/27/98), and data analysis is in progress.

Significant events

Both Gene Capelle and Andy Schuerger attended and presented at the CMST-CP Annual Review Meeting.

At the request of STL, Andy attended several sessions on vegetation monitoring at the SPIE AeroSense '98 conference (International Society for Optical Engineering) in Orlando, Florida. He was approached by Dr. Scott Needham, a remote sensing research scientist from Weyerhaeuser Corp. (timber products). Needham is interested in field use of an aerial LIFI platform to measure canopy health of loblolly pine in 3.5 million acres of forest nurseries in the southeast U.S. to determine stand vigor. He is interested in establishing a direct collaboration and indicated that some Weyerhaeuser research funds may be available to support joint work. This contact is fortuitous because we were already gearing up to look at loblolly pine because it is a species growing on many DOE sites. Such an interaction would also benefit Walt Disney World by helping to understand tree stress via remote sensing that could then be applied to mitigating transplant shock and water stress problems currently encountered with transplanted trees.

Rob Fisher and Jeffrey Ruby from the U.S. Army Corps of Engineers, Topographic Engineering Center, Alexandria, Virginia, visited EPCOT in April to discuss an exchange of data. Both individuals are funded by the Corps to develop a database of existing spectral reflectance and thermal imagery from plant species and non-living targets. Tens of thousands of spectra were collected over the last 15-20 years, but the data are not easily accessible. Fisher indicated interest in our plant fluorescence data because their database contains little fluorescence information. We will provide fluorescence data to them; in exchange, they will give us access to the new database—expected to be on line in September.

Accomplishments and technical progress

The STL software specialist has solved all software and hardware issues in the robotic arm system. Research plants in the robot plot were seeded on April 28, and fluorescence/spectral reflectance data will be taken with the robot system starting May 15. These measurements are designed to measure the daily and weekly fluctuations of healthy bean and wheat plants.

The LIFI/LIFS system was returned from the March data take at EPCOT and was set up at STL. The laser power supply for the LIFI system that failed, requiring us to use a backup power supply during the EPCOT data take, was sent to the laser manufacturer for repair. It will be another week or two before it can be returned. Meanwhile, standard lamp curves were collected with the several LIFS configurations. The

LIFS response was then folded with the lamp response to give a correction curve to apply to spectra collected with the LIFS system, allowing us to produce fully corrected spectra. The more than 800 spectral traces collected by the LIFS system during the March data take at EPCOT were processed into approximately 150 Excel files (one for each plant), each containing various fields of view and the background spectra, plus the spectral correction factor. Copies of these files were sent to EPCOT so that both groups can work on the analysis. Data analyses also began on the other remote sensing and plant morphometrics data collected last month for bahia grass, bean, and wheat plants, using LIFI, other fluorescence and hyperspectral systems, fluorescence spectrophotometer, modulated chlorophyll fluorometer, etc. The quantity of data precludes rapid analyses; however, a quick look indicates that all of the equipment worked very well.

Examination of neural net analysis techniques for spectral data is beginning at STL. We will start with analysis of the same data set that is being used with the “higher-order derivative analysis” technique, applied by Charles Bostater of Florida Institute of Technology. Simple analysis techniques for the fluorescence spectra, e.g. red/far red ratio, could separate only the 0-ppm zinc batch from all other treatments. Preliminary results indicate that the derivative analysis may be able to resolve all treatments (zinc levels of 0, 0.15, 0.3, 20, and 40 ppm).

All parts for the portable weather station were received. The system will be set up in the research plots in the Land “show” greenhouse by the end of April and will be used to collect environmental data in the robotic arm system plots and the research plots on the north side of the boat ride.

Assessment of current status

The cumulative schedule variance is -15%, which is due to a delay in billing of contracted services. The cumulative cost variance is 0%.

Plans for the next two months

The second joint (STL/Dynamac) data take will occur at EPCOT in June. We will coordinate with collaborators for possible publication.

During the first week of June, we will meet with project facilitators at EPCOT for their orientation and technical discussions. It is also possible that we will engage in a LIFI/LIFS data take at the “Geospatial Information in Agriculture and Forestry” conference in Orlando.

We will continue plant measurements (Dynamac at EPCOT): wheat, bean, bahia grass, plus add loblolly pine to baseline natural variances and controlled stresses.

Data collection begins in earnest with robotics-sensor system that STL built and maintains, and Dynamac operates.

We will begin to investigate new data analysis techniques: neural net analysis (STL), derivative analysis (Dynamac-FIT).

STL will further investigate the applicability of green fluorescent protein to the goals of this project.

STL will investigate fielding possibilities at Savannah River Site.

PI: Gene Capelle, Special Technologies Laboratory, (805) 681-2252

Remote Surveillance of Facilities Awaiting Decontamination and Decommissioning

Project objectives

Many DOE sites—Albuquerque, Chicago, Idaho, Oak Ridge, Savannah River, etc.—require remote surveillance of their facilities like production areas, structures, utilities, equipment, drums, tanks, effluent lines, etc. Many of these facilities are awaiting deactivation and decommissioning (D&D) and must be periodically surveyed for various criteria including structural deterioration, water intrusion, animal intrusion, integrity of storage containers, atmospheric conditions, and hazardous substance release. The surveys are intrusive, time consuming, and expensive, and they expose the survey personnel to radioactive contamination.

This project will develop a remote surveillance system to provide continuous monitoring of the facility and reduce the need for labor-intensive and hazardous surveys. Most of the components are available in the market or are being developed by the CMST-CP, the Tank Focus Area (TFA), or other OST Focus Areas. These sensors must be evaluated for the purpose of remote surveillance. Because no single technology can meet the requirements, there may also be a need to develop or design a remote system combining sensor technology with data storing and processing technologies.

The surveillance system with incorporation of characterization technology will allow continuous monitoring, coupled with source location and measuring required properties and transferring the data to a remote monitoring station. Although the surveillance needs are site- and facility-specific, some of the system features will be common to all. The system will consist of four principal modules: a sensor set, a multi-channeled data logger, a data transmission module, and a power supply. The objective of this project is to develop and implement such a system. The project is organized in two major phases: DOE surveillance needs review and prioritization, and system development.

Significant events

The project's progress was presented at the CMST-CP Annual Review Meeting.

Accomplishments and technical progress

A survey form was sent to nearly 100 data logger vendors. As a follow up, some vendors were contacted by telephone to elicit an early response.

The completed survey forms were received from some of the vendors of technology for sensors, data loggers, transmitters, and integrated units. A table presenting the different surveillance system components available from various vendors was prepared.

A CMST database search for more vendors began. The survey form was emailed to some of the vendors.

Plans for the next two months

The survey form will be sent to more technology vendors. Based on their responses, a summary of the available technologies and related functions will be prepared.

Based on Project Baseline Summaries and Site Technology Coordination Group needs, we will establish contacts with site personnel at one or more DOE sites in need of characterization, monitoring, and remote surveillance of facilities. Mr. Jim Goodenough from Hanford has shown interest in remote surveillance technology.

PI: M. A. Ebadian, Florida International University, (305) 348-3585

Measurement of Alpha Contamination on Surfaces Using an Electret Ion Chamber

Project objectives

In and around nuclear plants such as vitrification plants, fuel reprocessing plants, uranium plants, thorium plants, waste storage facilities, reactors and radiological laboratories, surfaces, and soil may become contaminated with alpha-emitting radionuclides. It is important to be able to measure such contamination and classify it as below the permissible levels, which are low. The DOE requires low cost, reliable methods for measuring low levels of alpha contamination. At present, surface alpha contamination is measured by handheld alpha detectors or by wipe test, and floor contamination is measured by floor monitors. A wipe test gives information about the transferable contamination only. Handheld alpha survey meters are difficult to use on floors, particularly when large areas are to be surveyed and when the contamination level is low. Floor alpha contamination monitors suffer from low sensitivity. Further, because alpha particles have a small range (~ 4 cm in air or ~ 5 mg cm⁻²), the detector window should be extremely thin, and the detector should be placed in intimate contact with the floor. This often leads to the damage/puncture/contamination of the detector/window.

An electret ion chamber (EIC) is an alternate technology for measuring surface alpha contamination. An EIC is passive charge integrating, which enables it to collect ions produced by alpha radiation over a long time and therefore detect very low levels of alpha contamination. The EIC can be used without a window or with a thin (0.8 mg cm^{-2}) Mylar window. The puncturing of the window because of a rough surface does not affect its performance. Electret chambers are inexpensive and can be disposed of if contaminated. EICs are commercially available. Many of them can be deployed simultaneously to measure surface contamination in any large facility.

This project will calibrate two commercially available electret ion chambers (EICs), volumes 145 ml (area, 48 cm^2) and 960 ml (area, 180 cm^2) respectively, for their response to different energy alpha sources. Sensitivity checks will be performed, and useful ranges for different chamber-electret combinations will be determined. The project will demonstrate the usefulness of the EICs at a DOE site, and will deploy them as a surface contamination measuring device.

Accomplishments and technical progress

The response of a 960-mL EIC was studied using three additional alpha sources (^{237}Np , ^{239}Pu , and ^{244}Cm) of known radioactivity. This chamber has an opening of 180 cm^2 , through which alpha particles enter the chamber and cause the ionization of the air inside the chamber. The ion pairs are collected by the electret, resulting in its charge (or voltage) reduction. The response of the electret is expressed in units of change in electret voltage per minute per unit becquerel of radioactivity. A 960-mL EIC with an open down-facing window was positioned above each source so that the chamber center line aligned with the source center. The response of the electret was measured at various electret voltages. Figure 1 shows the response curves.

The responses of electrets of different thicknesses (0.127 mm thick called a long-term electret; 1.58 mm thick called a short-term electret; and 4.76 mm thick called a sensitive electret) were determined and are shown in Figure 2. It is evident in Figure 2 that the response of the electret increases with electret thickness. Short-term electrets can be used for short time measurements where the contamination levels are low. Long-term electrets, in contrast, are useful where contamination levels are large or measurements over extended periods are required. Accordingly, long-term electrets have large dynamic ranges ($\text{Bq} \times \text{minutes}$).

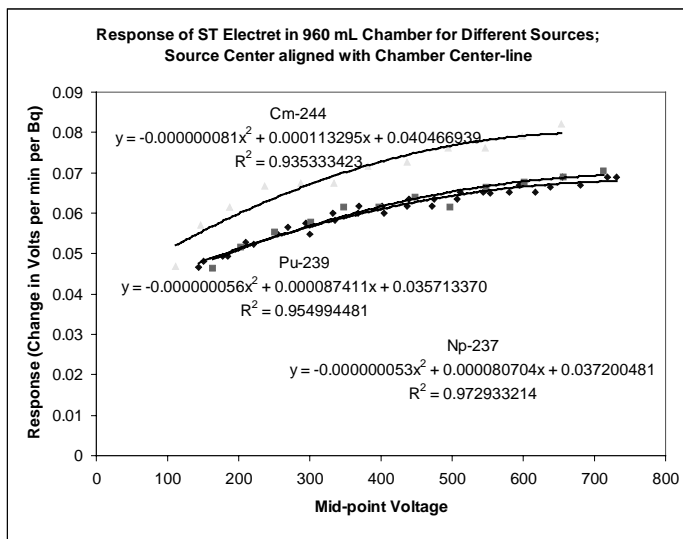


Figure 1. Response of short-term electret in 960-mL chamber for different alpha sources at various midpoint voltages.

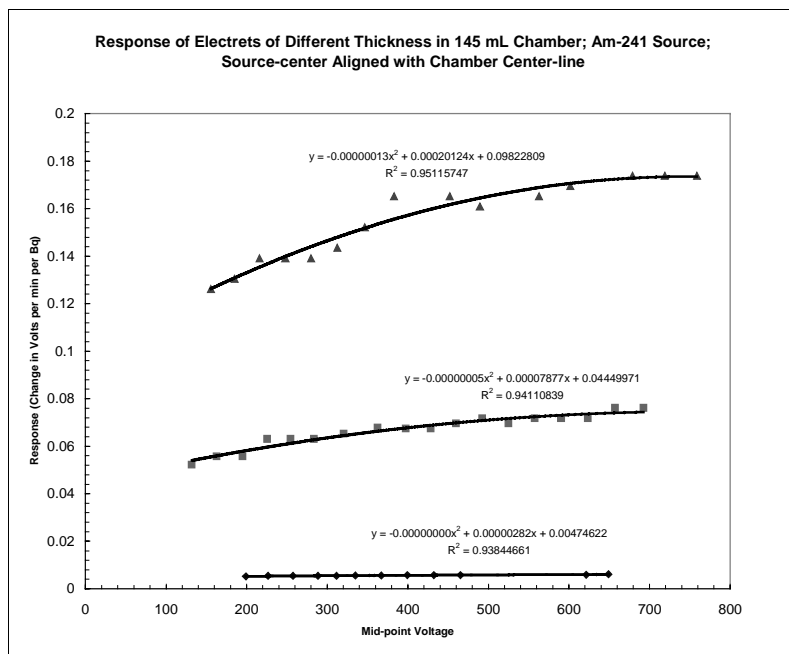


Figure 2. Response of electrets of different thicknesses in a 145-mL chamber at various midpoint voltages.

Assessment of current status

Although this project was initiated in November 1997, the actual project work began in January 1998 when the scope of the project was redefined.

Plans for the next two months

The response of both chambers for different alpha sources will be determined for different distances of the sources from the chamber center-line.

PI: M. A. Ebadian, Florida International University, (305) 348-3585

Process Monitoring

On-Line Measurement of the Progress of Decontamination

Project objectives

The accurate characterization of contaminants is a critical task during several phases of deactivation and decommissioning (D&D) operations. Depending on the nature of the contaminants and the characterization objectives for a given remediation, the degree of sampling and analyses required for D&D can significantly increase remediation costs.

This project focuses directly on in-process characterization. Present characterization technologies typically require the cessation of decontamination activities while the removed and/or remaining contamination is assessed. The aim of this project is to find in-process characterization methods, especially in the area of radiation sensors that can be integrated with a suitable decontamination technology to combine decontamination and characterization activities. A decontamination instrument with characterization and data collection technologies incorporated into it would allow for continuous decontamination activities, coupled with real-time assessments of the amount of contamination removed and/or the amount remaining. The result would be an overall gain in productivity accompanied by cost and time savings.

A key objective of this project is to combine an existing decontamination technology with commercially available characterization technologies to develop a prototype instrument that will be assessed and then commercially deployed. A closed-system decontamination technology that uses a vacuum or contaminant collection system will be selected and integrated with appropriate radiation sensing devices and data collection components. This integration of technologies will yield an improved instrument that may be continuously operated, removing contaminated materials and simultaneously assessing the removal progress.

Significant events

A presentation summarizing the progress of the project was prepared and given at the CMST-CP Annual Review Meeting. The presentation not only provided the CMST-CP with a valuable project update, but allowed the project manager to glean valuable program information and suggestions regarding the project.

Accomplishments and technical progress

Several integration designs were generated using the building block designs from last month. The most promising integration design was chosen and is being evaluated through extensive vendor interface and feasibility studies.

The first feasibility study to be performed will be an evaluation of radiation detector efficiencies as a function of speed and distance from the detector. The conceptual design of the hardware for this feasibility study was generated during previous months, and the specifics of the design were delineated during April. This was accomplished through extensive vendor interface and in-house engineering design activities. The study will be performed to supply specific data regarding gamma detectors. The purpose for the study was the lack of data available from the vendor of the detector array being proposed for integration (they only had data pertaining to alpha and beta detectors).

A special lightweight polymer was discovered as part of a concurrent Hemispheric Center for Environmental Technology (HCET) project, and evaluation of its radiation transmission properties will be included as part of the feasibility study mentioned above. If the polymer is found to transmit sufficient amounts of radiation, it may be used as a means of abrasion detection for detectors used in the field. The vendor agreed to supply the samples required to perform the analysis and is cooperating with the study.

Detailed investigations were conducted with respect to radiation hardening of electronics used in radioactive environments and radio frequency (RF) modem interference due to radiation.

An investigation also began to evaluate the impact of decontamination technology noise levels on the ultrasonic positioning system currently being used by the vendor of the detector array. Work will continue next month to determine if this is a significant issue and if any system components need to be replaced or redesigned as a result of excessive noise.

The vendor of the detector array was given the specifics of a modified detector array that will be purchased for the project and integrated with the decontamination technology. The vendor is preparing a price estimate and terms of delivery and has also agreed to address several technical issues before issuing the quote.

Work continued to locate project end users.

Plans for the next two months

Vendors will continue to be consulted to further evaluate the performance parameters of their technologies.

A quote will be generated for purchase of the detector array that will be integrated with the decontamination technology.

The feasibility study will continue with the purchase of related hardware and the generation of the test plan.

Samples of the polymer will be obtained from the vendor for inclusion in the feasibility study (to evaluate radiation transmission through the polymer).

The end-user search and consultation will continue, using the conceptual integration design presented at the CMST-CP Annual Review Meeting.

The base technology will continue to be evaluated for integration design considerations. The unit was received in April.

Design work will begin on the mechanism that will connect the detector array with the decontamination technology.

Additional information on the detector array will be compiled and, if possible, a hands-on demonstration will be viewed.

PI: M. A. Ebadian, Florida International University, (305) 348-3585

Program Coordination

Characterization, Monitoring, and Sensor Technology Technical Team and Facilitator Activities at Environmental Measurements Laboratory

Project objectives

This project provides field technical support for CMST-CP activities. It involves and contributes to identification of technology needs; assessment of technology requirements, capabilities, and limitations; promotion of technology integration; assessment of technology development opportunities; and program planning and implementation.

Significant events

CMST-CP annual review meeting:

Technical experts Adam Hutter, Paul Goldhagen, Alfred Cavallo, Peter Shebell, Robert Leifer, Anna Berne, Pamela Greenlaw, Michele DeGennaro, and Raymond Lagomarsino attended the meeting and moderated breakout sessions.

Catherine Klusek, CMST-CP field technical manager, gave a welcome address and an introductory overview.

Adam Hutter, Focus Area lead, gave a brief introduction on deactivation and decommissioning (D&D). He also gave a presentation on the relationship between the CMST-CP projects and the international projects of the Joint Coordinating Committee on Environmental Restoration and Waste Management (JCCEM), the managing body of a Memorandum of Cooperation between the DOE (OST, EM-50) and the Ministry of Atomic Energy for the Russian Federation (RF MINATOM). The JCCEM, with seven focus areas, conducts collaborative Russian/American technology development activities of mutual benefit in environmental restoration and waste management.

Colin Sanderson participated as a technical reviewer for the following projects: (1) "Demonstration of Emerging Continuous Emissions Monitoring Technologies"; (2) "DOE Laboratory/Industry Performance Demonstration"; (3) "Portable X-ray, K-edge Heavy Metal Detector"; (4) "SCAPS Logistics"; and (5) "Technology Application for Field Sampling Systems."

Cristina Jaw, Raymond Bath (director, Quality Assurance/Metrology Division) and Mitchell D. Erickson (director, EML) also attended the meeting.

Accomplishments and technical progress

Visit to FIU. Pamela Greenlaw visited Florida International University (FIU) in Miami on April 16 to tour the facility and to meet with the program manager of the Analytical Laboratory at the Hemispheric Center for Environmental Technology (HCET). She also toured the other DOE projects, including the D&D demo area.

Participation in DOE/Utilities consortium. Adam Hutter attended a meeting of the DOE/Utilities Consortium, April 22 and 23, at FIU. The Consortium's goal is to identify, demonstrate, and deploy D&D technical solutions for the nuclear utility and DOE sites that will improve D&D effectiveness, enhance worker health and safety, and reduce D&D schedule, durations, and costs. Among the Consortium's members are representatives from the DOE Headquarters, FETC, Chicago Operations Office, Argonne National Laboratory, FIU, Electric Power Research Institute, and several utilities, including ComEd, Duke Engineering, Consumers Energy, and GPU Nuclear and Yankee Atomic. A Motorola Roadmapping exercise was conducted to help steer the group to solutions of mutual interest and resulted in the identification and direction for solving five broad areas requiring technical solutions beneficial to both the DOE and the Utilities.

DOE Chemical Analysis Automation technology workshop. As requested by Charles Nalezny, Raymond Bath and Pamela Greenlaw attended the DOE-sponsored Chemical Analysis Automation (CAA) technology workshop and demonstration in Gaithersburg, Maryland, on April 30. CAA is an EM-50 sponsored program within the Robotics Technology development program. Actual site performance data was presented by Oak Ridge National Laboratories.

EML integration activities:

Catherine Klusek briefed EML principal staff on the status of the process of integrating technical support into the CMST-CP as well as upcoming events and initiatives.

Paul Wang's computer arrived in damaged condition from Nevada. It was checked out by staff from EML's Technical Program Services Division. Arrangements and documents for repackaging and shipping to CTC were handled by Kevin Clancy, support services specialist.

Kevin Clancy and staff from the Technical Program Services Division are working with Mary Alice Bodnar, Headquarters, to certify EML's video conferencing system.

A monthly meeting of the EML facilitators was held April 17 to discuss the FY98 CMST-CP Annual Review Meeting, future travel plans, the role of the facilitator, and other areas of concern and interest.

Facilitator activities:

SCAPS Logistics - Cone Penetrometer. Raymond Lagomarsino visited the Savannah River Site on April 30 to attend the demonstration of the Science and Engineering Associates developed Cone Permeameter™ Technology. He also visited the Integrated Demonstration Site to observe the operation of the DOE Site Characterization and Analysis Penetrometer System (SCAPS) truck.

JCCEM Contaminant Transport Studies. On April 9, Adam Hutter and Michael Foley (PI for JCCEM/CMST project, Pacific Northwest National Laboratory) briefed Charles Nalezny (EM-53) and Gerald Boyd (EM-50) on the progress and future work of the JCCEM Site Characterization & Contaminant Transport Focus Area of which Dr. Hutter is the Technical Program Manager. Discussions are ongoing concerning expanding and refocusing current and future studies to address vadose zone issues at the Hanford site. Adam Hutter communicated this new interest area to the Russians and received a proposal package for new work for this fiscal year and beyond. Michael Foley is discussing the applicability of the Russian contaminant migration databases to the Hanford site. After technical issues have been addressed at Hanford, work plans will be drafted.

Alternative Landfill Cover Demonstration. Michelle DeGennaro is in contact with Steve Dwyer and Jesus Lopez, Sandia National Laboratory (SNL), to obtain information on the alternative landfill project. She is reviewing the Gate 4 review document and is also in contact with Dave Roelant concerning updated and ongoing reports.

Support to program management:

Catherine Klusek attended the Subsurface Contaminant Focus Area (SCFA) Mid-Year Program Review in Augusta, Georgia. She also attended a meeting at the SCFA Mid-Year Program Review on Long-Term Landfill Covers led by Scott McMullin, Product Line Manager.

Catherine Klusek discussed the results of the FY98 CMST-CP Annual Review Meeting regarding the alternate landfill covers with George Allen, Tom Burford and Jesus Lopez, SNL.

Catherine Klusek discussed the Be monitor proposals with Ron Staubly, FETC, and provided him with an issues paper.

Rita Rosen provided biographies of CMST-CP facilitators used for the FY98 CMST-CP Annual Review Meeting to Greg Gmurczyk as a basis for information to be put on the Web site.

PI: Catherine Klusek, CMST-CP Field Technical Manager, (212) 620-3231

CMST-CP Field Coordination at Concurrent Technologies Corporation

Project objectives

This project provides expert technical program integration and field coordination for the CMST-CP. It is focused on strategizing the CMST-CP technology development multi-year program plan and developing a road map that guides the plan implementation.

The road map process consists of the following elements: identifying technology needs; assessing technology requirements, capabilities, and limitations with respect to meeting the identified needs; prioritizing technology development activities according to the impact of overall cost savings for DOE sites; soliciting and promoting development of technology solutions in high-priority technology deficiency areas; monitoring technical progress of projects; and promoting technology deployments to meet site 2006 Plan objectives.

Major milestones

- Publish Technology Gap Analysis Document; due 4/30/98. The draft document has been submitted to program management; this milestone is complete.
- Coordinate Annual Review Meeting; due 5/31/98. The CMST-CP Annual Review Meeting was successfully conducted April 7-9; this milestone is complete.

Significant events

CMST annual review meeting. The FY98 CMST-CP Annual Review Meeting was held April 7 to 9 in Gaithersburg, Maryland. During the meeting, the PIs from 24 CMST-CP funded projects presented information about their progress in FY98. Nineteen of these projects were reviewed by 16 technical experts and seven Focus Area representatives; the remaining five projects were informally reviewed by the Focus Area representatives and audience members. More than 90 participants attended the meeting. All reviews are being compiled for official distribution in May.

Accomplishments and technical progress

Support to CMST-CP program management:

- Completed and submitted a preliminary draft of the Subsurface Contaminants Focus Area (SCFA) section of the CMST Technology Needs and Gap Analysis Report. The draft identified the related Site Technology Coordination Group (STCG) needs, related Project Baseline Summaries (PBS), planned technology development and deployment actions and schedule to meet site requirements, related CMST-CP technical task plans, linkage with ongoing development/deployment activities within the OST, and potential impact of technology implementation for several SCFA areas, including (1) barrier emplacement and integrity, (2) DNAPL delineation, (3) subsurface contaminants measurements, and (4) treatment and chemical stabilization monitoring.
- As requested, attended the first day of the OST Internal Review Budget Meeting on March 31 to answer technical questions related to CMST-CP FY2000 work packages. During the meeting, participated in several breakout sessions with individual Focus Area teams. A trip report was submitted to the CMST team members.

- Prepared a summary analysis showing the correlation of the CMST-CP FY2000 work packages with the OST prioritization results and the impact from the two budget reduction levels. Submitted the file to Catherine Klusek and Charles Nalezny.
- As requested, attended a meeting with Charles Nalezny and Catherine Klusek on April 20 in Germantown, Maryland, to plan for the FY99 portfolio. In preparation for the meeting, summarized all reviewer comments from the FY98 CMST-CP Annual Review Meeting.
- Prepared a Fact Sheet on data fusion technology and submitted it as requested on April 13.
- As requested by Catherine Klusek, reviewed and suggested changes to the draft American Society of Mechanical Engineers (ASME) review criteria for technologies applicable to characterization and monitoring of dense, nonaqueous phase liquids (DNAPLs).
- Prepared presentation materials for Catherine Klusek's opening presentation at the CMST-CP Annual Review Meeting. The materials included information about CMST-CP customers, the major problem areas targeted by the DOE EM, the life-cycle cost estimates for cleanup, the budget profile by waste type, the CMST-CP FY98 budget and program portfolio, the annual review meeting purpose and review evaluation criteria, the CMST-CP program policy factors, the annual review meeting outcome, FY99 and beyond, CMST information resources, and CMST-CP technical team members.
- As requested, compiled a status report for all of the CMST-CP FY98/99 projects with associated Tech ID numbers and transmitted this information to the Programmatic team on April 16.
- As requested, compiled and prepared weekly highlight contributions from CMST-CP team members for submission to DOE Headquarters management for consideration of inclusion in the OST weekly highlights publication.

Publications:

Prepared the March CMST Monthly Progress Report with selected highlights and distributed 68 print copies to DOE managers and other interested parties. The report was also posted on the CMST Internet site (www.cmst.org).

Worked with Dale Norton of WPI and completed a draft article entitled "Spotlight on the Characterization, Monitoring, and Sensor Technology Crosscutting Program," to be published in the August edition of *Initiatives*.

A paper entitled "Overview of Development in Continuous Emissions Monitoring for Mixed Waste Treatment," was posted on the CMST Internet site (www.cmst.org) on April 7. The paper (by William J. Haas, Jr., Stephen J. Priebe, Daniel B. Burns, Nina

Bergan French, Paul M. Lemieux, and David A. Hutchins) was presented at the WM '98 Conference in Tucson, Arizona, on March 3.

Assessment of current status

Project schedule and cost variances are within the threshold.

Plans for the next two months

Documentation of the review results from the CMST-CP Annual Review Meeting will be completed and submitted to DOE Headquarters for official distribution.

Two papers will be prepared for submission to Spectrum '98: "A Streamlined Process for Facility Characterization" and "Evolution of Characterization and Monitoring Technologies for Groundwater and Soil." In addition, an abstract will be submitted to TechnoVentions '98.

PI: Paul Wang, Concurrent Technologies Corporation, (412) 826-5320, ext. 243

Characterization Crosscutting Program Technical and Programmatic Support at Special Technologies Laboratory

Project objectives

This project provides field technical and programmatic support for CMST-CP activities. It involves and contributes to identification of technology needs; assessment of technology requirements, capabilities, and limitations; promotion of technology integration; assessment of technology development opportunities; and program planning and implementation.

Major milestones

- Publish Technology Gap Analysis Document; due 4/30/98. The draft document has been submitted to program management; this milestone is complete.
- Coordinate Annual Review Meeting; due 5/31/98. The CMST-CP Annual Review Meeting was successfully conducted April 7-9; this milestone is complete.

Significant events

Paul Hurley, David Roelant, and Stephan Weeks attended the CMST-CP FY98 Annual Review Meeting in Gaithersburg, Maryland. Hurley and Weeks served as meeting facilitators, leading breakout sessions as assigned with project presenters and reviewers.

Accomplishments and technical progress

Completed management support tasks. Roelant completed: (1) the CMST Annual Report, which has been put on hold by Headquarters, (2) work on FY97 technology

deployment fact sheets, (3) a Microsoft Project file to track CMST-CP FY98 milestones, and (4) preparation of slides for (a) the CMST-CP Field Manager and the CMST-CP deactivation and decommissioning (D&D) lead to present at the CMST-CP Annual Review Meeting and (b) possible presentation at the D&D Midyear Review Meeting in May.

Continuing management support tasks. Roelant and Weeks continued collecting information on technology deployment fact sheets. Weeks continued TMS information updates and reviews, and Roelant continued updating and inputting new data into the TMS database. Roelant collected explanations on project overdue milestones and cost/schedule variances for monthly Business Review presentation, and Weeks participated in supplying related information. Weeks responded to a data call for linkage table information. Roelant continued collecting information on the Alternative Landfill Covers Demonstration project for Headquarters and Environmental Measurements Laboratory.

New management support tasks. Roelant initiated collecting information (1) for the CMST Technology Summary “Rainbow” Book and (2) on FY97 funding to develop and deploy three technologies, as requested by EM-50.

DOE-Ohio collaboration. Roelant participated in week long Value Engineering Study of D&D of external areas at the West Jefferson site under DOE-Ohio and completed work on the final document for the Study.

RCI meeting / NTS visit. Hurley traveled to Las Vegas, Nevada, to participate in a Rapid Commercialization Initiative (RCI) meeting and to observe certification testing at the Nevada Test Site (NTS). Steve Cooke of FETC called the RCI meeting to complete a final report on Waste Inspection Tomography (WIT). Hurley has participated in the program for the last four years. The meeting was successful in reaching agreement among the attendees for a final document that should prove satisfactory—however, an EPA sign off is still needed. The WIT system is now operational for nondestructive assay of waste drums and is able to compete for contracts with DOE sites. WIT is currently undergoing Carlsbad Area Office (CAO) certification at the NTS, which Hurley observed during his trip. Canberra and Trutech (a neutron system formerly known as APNEA) are also undergoing certification testing, and the NTS will take the opportunity to be certified by the CAO for waste disposal. While at the waste disposal site, Hurley met with Mike Griffin to discuss possible applications of the Associated Particle Imaging system to waste drums of interest to Bechtel Nevada.

Facilitator activities. Weeks conducted a facilitator visit to Ames Laboratory for the project “Development of a Multi-element Metal Continuous Emissions Monitor for compliance” and reviewed work on the new spectrometer. Regarding the “Development and Deployment of Innovative Dense Nonaqueous Phase Liquid (DNAPL) Characterization Methods” project, Weeks began discussions concerning the

OST peer review and responded to a request from Catherine Klusek for comments on related documentation. Weeks also helped facilitate plans for deployment of a neural network Raman cone penetrometer probe during the DNAPL field evaluation at Savannah River Site scheduled for late May.

Technical reviews. Roelant reviewed two Small Business Innovative Research (SBIR) proposals for radiation detectors/imagers.

Tritium workshop. Roelant continued collaboration with Desert Research Institute for their upcoming workshop on tritium groundwater problems and possible solutions.

STCG support. Roelant identified Site Technology Coordination Group (STCG) needs relevant to CMST D&D projects, continued analysis of STCG needs related to CMST FY98-99 projects, and responded to requests from the Oak Ridge STCG regarding D&D technologies for their site and from other DOE STCGs.

Weekly highlights. Weeks and Hurley submitted contributions for the CMST weekly highlights.

CMST-CP conference calls. Hurley, Roelant, and Weeks participated in scheduled conference calls as directed.

Assessment of current status

Both schedule and cost variances are within thresholds. The cumulative schedule variance is 7%, and the cumulative cost variance is 7%.

PI: Paul Hurley, Special Technologies Laboratory, (805) 681-2472

Characterization Crosscutting Program Technical Support at Ames Laboratory

Project objectives

This task provides technical support and assistance in field coordination and program support for the CMST-CP. It involves and contributes to identification of technology needs; assessment of technology requirements, capabilities, and limitations; promotion of technology integration; assessment of technology development opportunities; and program planning and implementation. Bill Haas and Glenn Bastiaans work as members of the combined DOE Headquarters (HQ) and field CMST-CP management and implementation team, providing technical and other support, as directed, to the CMST-CP HQ Program Manager and the CMST-CP Program Coordinator.

Major milestones

- Assist the Mixed Waste Focus Area (MWFA) in identifying CMST development and performance requirements; provide MWFA CMST need statements to the CMST-CP program manager and program coordinator for potential inclusion in calls for proposals (PRDA, ROA, SBIR, STTR, and TTPs)—due 4/30/98. This milestone was completed. Contributions were made to the CMST Multi-Year Performance Plan, the FY98 Performance Plan, and the Gap Analysis Report in the areas of the Tank Focus Area (TFA), MWFA, and Plutonium Focus Area (PFA)—for gap analysis.
- For each assigned CMST-CP project, conduct an on-site review of technical progress and schedule status; transmit the review report to the PI, the CMST-CP program manager, and the program coordinator—due 4/30/98. This milestone was completed. On-site reviews were conducted for assigned CMST projects that were scheduled for presentation at the Annual Review. Review reports were completed and submitted.
- For assigned projects, prepare draft program execution guidance (PEG), including draft input for technical scope, milestones, go/no-go decision points, and deliverables; provide draft material to the CMST-CP management team—due 7/15/98. This work will begin after the Annual Review results are evaluated and project funding decisions are made. The milestone is expected to be completed by the due date.

Significant events

CMST-CP annual review meeting. The CMST-CP Annual Review Meeting was held April 7 to 9. In preparation, Haas facilitated reviewer participation, worked with Paul Wang on reviewer nominations and assignments, and collected reviewer vitae. During the review meeting, Haas and Bastiaans served as presentation session moderators, facilitated reviewer breakout sessions, and facilitated wrap-up sessions. After the meeting, Haas transcribed the notes taken during the wrap-up sessions and sent them by email to Paul Wang and the CMST-CP management team.

Also while at the meeting, Bastiaans held separate meetings with:

- David Cremer, Shuh-Haw Sheen, Tom Thomas, Al Raptis, and Stephan Weeks to discuss possible collaboration between Science and Engineering Associates (SEA) and Argonne National Laboratory (ANL) in the area of suspended solids monitoring.
- Keith Hoffmann, David Seely, Bruce Friedrich, and Anna Berne to discuss technical plans for the 3M Empore membrane disk sampling project and to plan creation of an Innovative Technology Summary Report (ITSR) booklet on the technology

At the meeting, Bastiaans provided support to discussions between CMST-CP management and Florida International University (FIU) personnel on plans to expand collaboration between CMST-CP and FIU.

CMST-CP technology needs and gap analysis. Bastiaans and Haas wrote draft sections of the CMST-CP Technology Needs and Gap Analysis for the TFA, MWFA, and PFA. The draft sections were sent to Paul Wang, David Roelant, and Greg Gmurczyk.

Market for advanced continuous emissions monitors (CEMs). At the request of Stan Wolf, EM-54, Haas reviewed and provided written review comments to Wolf on the document, "The Market for Advanced Continuous Emission Monitoring Analyzers in Thermal Treatment." The document was produced for the FETC by the Global Environment and Technology Foundation.

Accomplishments and technical progress

- Milestones A-1 and A-2 were completed in April as planned. In completing milestone A-1, drafts of three sections of the CMST Gap Analysis were completed and forwarded to Paul Wang, David Roelant, and Greg Gmurczyk.
- Bastiaans started work on the creation of an ITSR on the 3M Empore field sampling technology in collaboration with Bruce Friedrich and Anna Berne. Validation of the cost benefit study was started.
- Bastiaans reviewed out-year project PEG documents drafted by the TFA.
- Bastiaans worked with FIU to create activity descriptions and milestones for an expanded collaboration with the CMST-CP.
- Bastiaans supplied written documentation on CMST-CP review practices to CMST-CP management.
- Bastiaans and Haas sent validated and updated information on deployments of assigned technologies to Greg Gmurczyk, SAIC.
- Per Chuck Nalezny's request, Haas sent information to Raymond Ball of Gannett Fleming Engineers and Planners, Braintree, New Hampshire. The information included contact information for persons able to furnish expert information regarding characterization and remediation of nonaqueous phase liquids (NAPLs) and dense, nonaqueous phase liquids (DNAPLs) at Pease Air Force Base and Loring Air Force Base, both fractured rock (granite) sites.
- Haas provided information to Bryan Albers, TRW, in support of Albers' role as TechnoVentions '98 conference manager.
- Haas sent the final version of the report on the April 1996 multi-metal CEM testing to Paul Lemieux, EPA Research Triangle Park (RTP). Lemieux is coordinating the generation and publication of an EPA document on that testing. Haas also sent a hard copy of Appendix L, as requested by Lemieux.

- Haas and Bastiaans updated and validated linkages between assigned CMST-CP projects and Site Technology Coordination Group (STCG) needs. They sent the information to Greg Gmurczyk, SAIC.
- Haas and Bastiaans sent input for weekly highlights to Tiffany Zachry, CTC.
- Haas and Bastiaans provided input to Greg Gmurczyk for the April CMST-CP Business Review. The input addressed the cost and schedule status of assigned CMST-CP projects.
- In initial response to Chuck Nalezny's request for an overview of CEM status, options, and proposed development program, Haas sent him the document, "The Market for Advanced Continuous Emission Monitoring Analyzers in Thermal Treatment." The document provides an overview of CEM development status, the drivers, and the current and near-term market. For another part of the initial response, Haas referred Nalezny to the document, "CEM Technology Development Strategy—A Process and Supporting Information to Establish a CEM Technology Development Strategy," which is available on the Web (<http://wastenot.inel.gov/mwfa/acrobat/cem.pdf>). Haas had previously provided a copy of the paper "Overview Of Development in Continuous Emissions Monitoring for Mixed Waste Treatment," which was recently presented at the WM '98 Symposium in Tucson.
- When contacted by Cheri Bahrke, editor for the *TIE Quarterly*, Haas recommended generation and publication of a story on the establishment and promulgation of an American Society for Testing and Materials (ASTM) Standard for Expedited Site Characterization (ESC). Al Bevolo, Ames Laboratory, has been working with Tom Starke, Los Alamos National Laboratory (LANL), and others, promoting an ASTM Standard for ESC. The work is nearly completed, and a Standard will be promulgated soon. Bevolo agreed to be interviewed and to draft a paragraph on the subject for the *TIE Quarterly*.
- At Chuck Nalezny's request, Haas sent information on the newly available BNFL IonSens 208 Large Item Monitor to Larry Stebbins at the Fernald Environmental Management Project. The monitor is based on the Long-Range Alpha Detector technology developed by Duncan MacArthur at LANL with CMST-CP support.
- Haas worked with Boris Faybishenko, Lawrence Berkeley National Laboratory, Richard Hane, Savannah River Technical Center (SRTC), and CMST-CP management to develop appropriate PEG documents and revised technical task plans for their projects.

- Haas reviewed and provided constructive written comments on the presentation visuals for the paper, "Results of the September 1997 DOE/EPA Demonstration of Multimetal Continuous Emission Monitoring Technologies," to be presented by Paul Lemieux, EPA, at the International Conference on Incineration and Thermal Treatment Technologies, Salt Lake City, Utah, May 11 to 15. The co-authors are: Paul Lemieux and Jeff Ryan, EPA, Nina French, Sky+, Inc., Bill Haas, Ames Laboratory, Steve Priebe, Idaho National Engineering and Environmental Laboratory, and Dan Burns, SRTC.
- In response to expressions of interest, Haas provided information to the members of the CMST-CP management team concerning the Direct Sampling Ion Trap Mass Spectrometer activities funded by the CMST-CP over the years.
- Haas began reviewing two DOE Small Business Innovative Research (SBIR) applications.

Assessment of current status

This project is on schedule.

Plans for the next two months

- Bastiaans and Haas will prepare draft PEG documents for assigned projects.
- Bastiaans will attend a planning meeting of the Canyon Deployment Initiative at the request of CMST-CP management. While in Richland, Bastiaans also will meet with Pacific Rim Enterprise personnel to discuss deployment of CMST technologies at the Hanford tank farms.
- Bastiaans is tentatively planning to visit FIU to support a meeting between CMST-CP management and FIU personnel to plan expanded collaboration.
- Bastiaans will be working with Anna Berne, Environmental Measurements Laboratory, and Bruce Friedrich, University of Iowa, to produce an ITSr on the 3M Empore field sampling technology.
- Haas will participate in the International Conference on Incineration and Thermal Treatment Technologies in Salt Lake City, May 12 to 14. While at the conference, Haas will also work with other members of the Continuous Emissions Monitoring Working Group, to begin updating the CEM technology development strategy document and to assist in planning a workshop on mercury continuous emissions monitoring.
- Haas will continue to assist in planning for TechnoVentions '98. As part of that work, Haas will participate in the May 27 to 28 meeting of the TechnoVentions '98 Technical Steering Committee.
- Haas will provide constructive written input to other members of the program team for the final version of the report on the September 1997 testing of multi-metal CEMs at the EPA RTP.

Continued

- Haas will be preparing an overview of CEM status, options, and proposed development program as requested by Chuck Nalezny.
- Haas will be preparing a cost saving analysis and ITSR for the Direct Sampling Ion Trap Mass Spectrometer technology.

PI: Bill Haas, Ames Laboratory, (515) 294-4986

CMST-CP Field Coordination at SAIC

Accomplishments and technical progress

Major activities included preparing, editing, and verifying information for the FY96 and FY95 Deployment Fact Sheets in both hardcopy version and on the Web within the Fact Sheet Builder. The TMS database was also updated. Eight such fact sheets were assembled for the verified deployments.

A set of summary notes based on the oral presentations at the CMST-CP Annual Review Meeting was prepared, edited, and distributed.

A monthly EM-50 Business Review report, covering data as of February and April, was prepared on the CMST-CP program status, achievements, problems, and plans, including correction actions.

The final version of the material and files for the Internal Review Budget (IRB) presentation was delivered to Headquarters, and graphics support was provided.

Graphics support was provided to the field in connection with the preparation of the deactivation and decommissioning (D&D) Annual Report.

An analysis of the FY98/99 Site Technology Coordination Group (STCG) needs was performed and linked to the CMST-CP technologies.

Several Project Execution Guideline (PEG) documents were modified. The signatures of PIs, Technical Program Officers (TPO), and the program management/lead for all CMST-CP PEGs were collected.

An organization and sorting effort of all CMST-CP documentation gathered during the past several years at Headquarters continued. A draft version of a CMST-CP progress tracking system was designed with the MS Project software.

The general activity throughout the month was communication and exchange of information on current tasks between the DOE Headquarters program management and field offices.

PI: Greg Gmurczyk, SAIC, (301) 924-6119